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ELECTRICAL EXPORTS FOR THE PAST FISCAL YEAR.

In another part of this issue will be found the usual monthly data on electrical exports according to the latest statistics furnished by the Department of Commerce, these covering the month of June and thus also the fiscal year ended June 30. The indications of the last few months that the year would show some extraordinary totals have been fully borne out by the actual figures that have just come to hand. The total value of electrical shipments was $26,772,816, which is an increase of about 33 per cent over the record established in the preceding fiscal year, 1911-1912.

These figures are naturally gratifying, but a still more suggestive fact is disclosed on examination of the tables in the article referred to. In the tabulated totals of each of the 12 months it will be observed that there was, with few exceptions, a general improvement from month to month, so that the second half of the fiscal year greatly exceeded the first half; in fact, March, April and May successively established new records in the neighborhood of the two and one-half million mark. This steadily improving trend is further shown in the table of annual totals. The retrograde movement for the two years following 1907 reached its minimum in the fiscal year 1908-1909, since which time there has been a steady increase until the total for the last fiscal year was over twice that of four years ago and over 50 per cent in excess of the preceding peak of six years ago. This maintained upward trend of four years, which has received such a marked impetus in the last few months, is a most auspicious indication of still further improvement.

Twelve months ago a new classification was adopted in the government export statistics and the former custom of reporting the principal countries of destination was dropped. The latter change was a distinct loss in that we no longer have readily available official data on how our export trade is divided among the various sections of the globe. The change of classification of electrical exports has been commented on in these columns before. An unfortunate feature of it is that from one-half to three-fifths of the electrical shipments are unsegregated in the indefinite "all other" class. Efforts have been made to have this large group at least partly subdivided and it is to be hoped that something may be done along this line.

Looking at the electrical export trade in general, it is to be noted that these shipments are increasing at a faster rate than the entire export business of the coun-

try. Despite the keen competition of foreign electrical manufacturers, the demand for American electrical products is rapidly increasing and there is every prospect that our own manufacturers will be able to supply an increasing share of the world's electrical trade. It is true that the tremendous electrical development in all parts of this country has taxed the manufacturing facilities of our producers of apparatus, so that many have not been able to keep up with domestic orders. But the increasing capital going into the industry, together with improved manufacturing methods and equipment, is bound to put our manufacturers in better position to meet the gradually broadening foreign demand for electrical machinery and miscellaneous apparatus.

ALUMINUM FOR CABLES.

The use of aluminum for overhead transmission lines has made considerable advance in this country of late years, but even yet it seems hardly to have gained the recognition which would be expected when one considers the relative properties and prices of the gross metal as compared with copper. Little or no use, however, has been made of aluminum conductors in underground work or for cases where insulation and armoring are required. Installations of this kind are to be found in Europe, however, where in a number of cases it has been found economically advantageous to make use of aluminum, even under these conditions. The principal disadvantage here on the side of aluminum is that it must have a larger cross section for the same conductivity and consequently the amount of insulating material and the amount of metal for the armoring is seriously increased.

Early in the summer a paper was presented in London before the Institution of Mining Engineers by Mr. Burkewood Welbourn, in which a detailed comparison of costs is given for various kinds of insulated cable and with various relative prices for the two metals. From a portion of this paper, which will be found elsewhere in this issue, it may be seen that under certain conditions aluminum has a definite advantage over copper, even in the case of cables which must be insulated and armored. While the prices of the two metals are not the same in this country as in England, the way in which Mr. Welbourn has made the comparison will enable anyone to take current prices and apply them to a comparison of the two metals. Even in this country there are no doubt cases in which an advantage will be found for aluminum. In the case of single-core, paper-insulated, lead-covered cable, with a section equivalent to 0.3 square inch of copper, it is found that aluminum will be the cheaper whenever its price does not exceed 4.8 cents per pound above copper. For wire-armored cable the conditions are naturally less favorable for aluminum. Other cases are pointed out where aluminum is decidedly inferior to copper from the standpoint of cost.

THE NEW YORK, NEW HAVEN AND HARTFORD ELECTRIFICATION.

The approaching completion of the electrification of the New York, New Haven and Hartford Railroad between Stamford and New Haven, and the rapid extension of electric service into the Harlem River freight yard emphasize anew the adaptability of the single-phase system for heavy trunk-line work and illustrate afresh the striking advantages of electric motive power over steam locomotives. When service is established between Stamford and New Haven, the entire main line of 73 miles from terminal to terminal between the Grand Central Station in New York City and the latter town will be operated by electric locomotives, both for passenger and freight traffic. This means that a complete "engine stage" will be electrified, and the operating economies of electricity will be given a fair chance to display themselves. Even with partial electric service a fine showing is reported by the New Haven officials, but it is obvious that no mixed system can perform as efficiently as one which is uniform in its engineering characteristics. Enough has been learned, however, to indicate that the electrification of the entire system is practicable along the lines now laid down, although the cost of such an undertaking on a network like that of the New Haven naturally makes it necessary to establish electrification first upon trunk lines and important suburban branches.

The installation of electric switching service at the Harlem River Yard, outside of New York, is one of the most interesting developments on the system. This is one of the largest freight terminals in the country, containing 86 miles of track, and is the first noiseless and smokeless freight yard of any size to be equipped with electric locomotives. The total car movement here averages 5,000 cars per day, and there are now over a half dozen electric switch engines constantly at work, more than half the service being thus handled. Complete electrification is being installed as fast as possible. In the electrified sections of the yard the absence of smoke and noise is striking. The classification of cars proceeds almost in silence, the only noise being an occasional squeak of a wheel or the sound of couplings coming together. The electric switcher goes about its task without showing any of the signs of distress common in the use of steam switch engines, and the volume of traffic which each machine handles is much greater than under the former steam conditions. Despite the fact that 500 men are constantly at work in the yard, with many on the tops of the cars and with a clearance of about two feet between the head and the catenary 11,000-volt trolley used in power distribution, no accident had occurred up to a very recent date, showing that the hazards in the electrified freight yard are practically no greater than in an ordinary one. Except at points where it passes under highway bridges, the contact wire is carried 22.5 feet above the top of the rail. The old "break-in-two"

lantern swinging signal cannot be used from the tops of cars, but need of this has been practically eliminated by the use of automatic air brakes. As a matter of fact much more work is done on the ground and less on the tops of the cars than formerly.

Electrification of the terminal has already shown many advantages. Cars can be picked up much more quickly by the electric locomotive and there is a saving of valuable time formerly lost in coaling and cleaning engines. A steam locomotive arriving from a long run requires two hours before it is ready for the return trip, compared with thirty minutes in the case of the electric locomotive. In the Westchester auxiliary yard two electric switch engines are doing the work for which three steam engines were formerly employed. Large civic improvements have also resulted from the electrification through the elimination of the noise and smoke of freight handling. New Rochelle, Mount Vernon, Woodlawn and Stamford also have electrically operated freight yards, and at these places no longer does the jerky switch engine, with its sharp exhausts and slipping drivers disturb the small hours of the night. The electrification of the freight yard in the Bronx has already resulted in the erection of apartment houses on land formerly considered undesirable. With the establishment of freight service by electric motive power between the New York terminal and New Haven, the days of the old-fashioned way freight, stopping to drop off cars at stations, will be past. In the zone between New York and Stamford way freight is now distributed from the Harlem River Yard by electric locomotives, thus enabling the main line to be kept much freer than in the old days.

THE SMALL DEALER'S STORE.

Whether it is generally profitable and best or not for the electrical contractor to be a merchant is a question about which there has been a great deal of discussion. Differences of opinion still exist. Without any attempt at argument on one side or the other of this question, it may be said that where the contractor has found dealing in electrical merchandise unprofitable faulty methods of conducting the business have often been the cause. Sound, authoritative advice as to how best to make the small electrical store pay is one of the things that have been most needed. The suggestions along this line in the article on "The Small Dealer's Store," by Mr. Richard E. Smith, which appears in another section of this issue, are ones that will be read with interest and ought to prove profitable to many readers.

Mr. Smith's contention that in order to reduce the percentage overhead expense it is sometimes necessary to increase the gross amount of the overhead per month or per year is in line with editorial matter which has appeared in this journal, as are also his remarks relative to the mistake made by the contractor who spends his own time on petty details of office work which could be taken care of equally well by a low-priced assistant. The figures that he gives to show how the way the store is run affects the overhead costs are doubtless fairly typical of many actual cases. His reasoning as to the location of the store is good; his statements as to the lighting of the place are timely.

We can hardly agree with Mr. Smith's opinion that the salesman in the electrical store need not be an electrician. A man who attempts to sell a thing that he doesn't understand is often seriously handicapped. Nobody would insist, of course, that the salesman of the commoner sort of electrical supplies and appliances need be an electrical engineer; but experience and observation have convinced us that he should at least be able always to explain accurately and simply the operation of any ordinary appliance that he may be called upon to sell, to tell the cost per hour of the energy needed to operate it, and to point out its advantages in a fair and convincing way. An elementary knowledge of electricity would be most helpful to him in this. It's a mistake to suppose that he doesn't need it.

A SUGGESTION CONCERNING ELECTRIC-VEHICLE ADVERTISING.

Manufacturers of electric commercial vehicles and central-station companies promoting the use of such cars, rightfully give prominence in their sales arguments to the advertising value in the use of these modern conveyances. It is true that the employment of an electric delivery system indicates progressiveness on the part of the user and the advertising accruing therefrom is an important consideration in comparing electric vehicles with other types, but it is safe to assume that under present conditions comparatively few people can readily distinguish an electric from a gas car.

Two pedestrians, apparently business men, were delayed on a busy corner of Chicago recently, awaiting an interruption in the traffic which at this particular time consisted principally of automobiles. Following several exceptionally noisy gasoline delivery wagons came two electrics, employed by a local bakery, and the marked contrast in their operation elicited from one of the by-standers the exclamation: "What easy running cars!" These men, it was subsequently learned, were unaware that the cars in question were of the electric type and an excellent opportunity to boost electric vehicles was lost.

This incident is probably occuring hundreds of times each day and it seems that some steps should be taken on the part of vehicle manufacturers to facilitate identification of electric cars. The word "Electric" or "Electric Delivery" on the battery box, for instance, would advertise the user to his customers and would advertise the electric car to the public in general. While a standardized identification would be preferable, if this is not feasible each individual manufacturer should make an effort to use the word "electric" on each car.

Electrical Exports For June and for the Fiscal Year 1912-1913.

The Bureau of Foreign and Domestic Commerce, Washington, D. C. has issued its monthly summary of the imports and exports of the United States for last June, and thereby has completed its annual summary for the fiscal year ended June 30, 1913. From this source are obtained the following interesting facts respecting the exports of electrical products.

Although below the record-breaking total for the preceding month, the total value of electrical shipments in June was over half a million dollars in excess of the corresponding figure in 1912. The detailed figures for June are given according to the government classification below, together with a comparative total of the corresponding month in 1912.

Articles.	No.	Value.
Dynamos or generators		$ 283,386
Motors		308,742
Fans	2,215	27,330
Arc lamps	260	4,574
Carbon-filament lamps	198,077	29,413
Metal-filament lamps	79,304	23,869
Telegraph instruments (including wireless)		10,094
Telephones		134,196
All other		1,493,128
Total, June, 1913		$2,314,732
Total, June, 1912		$1,783,102

The following table gives the totals of electrical shipments for the 12 months of the fiscal year ended June 30, thus showing the fluctuations from month to month.

Month.	Electrical Exports.
July, 1912	$1,932,619
August, 1912	2,100,761
September, 1912	1,852,400
October, 1912	2,078,501
November, 1912	2,270,553
December, 1912	2,186,264
January, 1913	2,217,625
February, 1913	2,219,969
March, 1913	2,489,374
April, 1913	2,551,131
May, 1913	2,558,887
June, 1913	2,314,732

In the following table are given the totals for the last seven fiscal years:

Fiscal Year.	Electrical Exports.
1906-1907	$17,268,406
1907-1908	15,249,436
1908-1909	12,524,391
1909-1910	14,742,395
1910-1911	18,727,455
1911-1912	20,169,362
1912-1913	26,772,816

Annual Convention of Railway Signal Association.

The annual convention of the Railway Signal Association will be held at Nashville, Tenn., October 14 to 17. Headquarters will be established at the Hotel Hermitage. The first three days will be devoted to formal sessions for the presentation and discussion of reports and papers. The last day will be given over to visiting Chattanooga for a view of the battlefields and other places of interest. Secretary C. C. Rosenberg announces that entertainment will be provided for the ladies during the various days that the meetings are in session and that the full program will be ready about September 15.

Pacific Electric Announces New Wage Scale and Increased Income to Employees.

Paul Shoup, president of the Pacific Electric Company, of Los Angeles, Cal., has announced an increase ranging from eight to ten per cent in the wages of all employees of the company operating on "high speed" trains as well as employees in work train and yard service. Under these increases men working full time will receive from $5 to $10 more per month than they did heretofore. This announced increase will make the payroll of the company between $10,000 and $15,000 larger than it has heretofore been.

In connection with these increases Mr. Shoup also announced that the seniority system will hereafter apply exclusively in the assignment of runs. In other words, the oldest and presumably most competent men will be assigned to the most important runs. In this way increased safety will be assured. Employees in all departments, other than those mentioned in the increase, such as employees in power houses, substations, electric line work, car inspection and repairing and maintaining, towermen, terminal station men, gatemen, as well as men employed in the offices, including the general offices, who wish to take advantage of these increases and enter the train and yard service, will be given preference over applicants not now in the company's service, conditional upon their qualifying for the service.

Chicago Section of Electric Vehicle Association Participates in Orphans' Day Outing.

At the meeting of the Chicago Section of the Electric Vehicle Association of America on Tuesday, August 5, a report was made regarding the participation of the Section in the Orphans' Automobile Day Association of Chicago. The latter will handle several hundred passenger cars and trucks and give a ride, luncheon and ice cream and candy to 2,000 orphans on Thursday, August 14. The Section is represented by Chairman Homer E. Niesz, George B. Foster and A. A. Gray. At the conclusion of the report cash donations were tendered the Association by Edwin E. Witterby, of the General Vehicle Company and L. M. Wagner, of the Anderson Electric Car Company, and passenger cars and trucks were offered by G. A. Freeman, of the Walker Vehicle Company, and C. B. Frayer, of the Edison Storage Battery Company.

Chairman Niesz announced that W. J. McDowell had been appointed to represent the Chicago Section in connection with the automobile features of Perry Day at Chicago, on August 23.

Telephone Consolidation Proposed.

It is possible that a consolidation of the telephone properties in Louisville, Ky., will be arranged, the municipal authorities having expressed themselves as being in favor of the plan. This seems to be particularly significant in view of the recent consolidation of the gas and electric companies of Louisville. The Cumberland (Bell) Telephone & Telegraph Company and the Louisville Home Telephone Company are now operating, the independent company apparently having the larger number of subscribers. The city and the Cumberland have been involved in litigation for a number of years regarding rates, and the city has been able to have its rate ordinance declared valid. The telephone company recently proposed a compromise, but its terms were not approved by the city.

The Cumberland Company has announced that $1,000,000 for new equipment and for a new building will be spent in Louisville. The building will probably be ten stories high and will cost about $300,000

Giant Turbo-Alternators for Philadelphia.

Joseph B. McCall, president of the Philadelphia Electric Company, has ordered two of the largest turbo-alternators that have ever been developed either in this country or abroad. It will be necessary to build a new generating station which will adjoin the present main generating station of the company located at Christian Street and the Schuylkill River, to accommodate the new equipment. The capacity of these turbo-generators will be respectively 35,000 and 30,000 kilovolt-amperes. The larger unit has an equivalent capacity of 46,666 horsepower. The details of each of the turbines are approximately the same—length 65 feet and net weight, 1,200,000 pounds.

Ten years ago the total station capacity was not as great as the capacity of the largest machine just ordered. Roughly, 35,000 kilowatts represents capacity sufficient to furnish service to a connected load of over a million lamps. This is a larger demand than is found at the present time in any but a few of the largest cities in the country.

Philippine Water-Power Development.

The Suburban Railway Company has been granted by the Government of the Philippine Islands the use of the waters of the Caliraya River in Laguna Province for power purposes. The company plans to supply the city of Manila and vicinity with electric power. Two other applications for water rights have been granted, the applicants being Carmer A. de Barber and Paul J. Bell.

An Analysis, by L. A. Osborne, of the Benefits of Co-operation through the Society for Electrical Development.

It may doubtless appear unusual to some that the electrical manufacturers should have so readily agreed to make liberal contributions to the funds of the Society for Electrical Development. In fact the readiness of the manufacturer to support the movement has led some to suspect that it was planned primarily in the interests of the manufacturer. Reflection, however, will show that the attitude of the manufacturer is merely co-operative in the broadest sense of the word and is an evidence of his appreciation that that which is truly co-operative is, in the last analysis, profitable.

Speaking as a manufacturer, we expect that our return will accrue after the central station, jobbers, dealers and contractors have begun to enjoy a measure of return as a result of the activities of the Society.

It goes without saying that the success of the movement will largely depend upon the spontaneity with which the different branches of the industry respond. There is a psychological moment when a movement of this character should be launched, and that is that moment when all are of the same mind as to its importance. Let that moment pass without definite action, and there is a danger of a weakening of that sustaining power of co-operation which is needed. If the different branches of the industry are willing in spirit, but lacking in financial help, those entrusted with the responsibility of making the work of the Society successful will not be encouraged to proceed with the confidence and enthusiasm which are so necessary in an undertaking of this kind; neither should they be handicapped by the necessity of seeking members, but should be permitted to exercise their talents in the legitimate activities of the Society which is broadly to impress upon the public at large the desirability of "DOING IT ELECTRICALLY."

The ideals of the Society are ambitious but attainable, and when carried out should, within a reasonable time, bring measurable returns to all branches of the industry.

The advertising planned by the Society to awaken an interest in things electrical should very early have an appreciable effect upon the trade of central stations, jobbers, dealers and contractors.

If, through such co-operative advertising, the architect, the contractor and the builder might be educated to the point that in all dwellings, regardless of cost, outlets for the use of electrical appliances should be plentifully provided, the business of the dealer in electrical appliances would be increased, as well as the work of the electrical contractor, and it goes without saying that there would be a corresponding increase in demand for current through which the central station would profit. The manufacturer secures his reward through an increased demand for his manufactured products, and, in the broader aspect of the case, in the ultimate increase in generating and distributing apparatus.

The general education of the people in the use of electrical vehicles brings its reward to the manufacturer of the vehicle, as well as to the makers of the motor and battery which propel it, and continuously to the central station providing the current for its operation.

When real estate dealers and investors are educated by co-operative advertising to make capital of electrically lighted and electrically equipped homes, then naturally an increase in business is bound to result therefrom, and as the ideas of men enlarge, the volume of increase will multiply rapidly. It is to our interest to educate the public to the feeling that that which yesterday was merely an electrical luxury is today a necessity.

When we can familiarize men in the professions—dentists, surgeons, doctors, etc., and in the multiplicity of trades, even the smallest and least important, with the value of doing things electrically, to make such men understand about things electrical, great will be the profit to the electrical business, and we will have realized, in part at least, one of the ambitions of the Society.

Especially should this movement appeal to central stations, even more than to the manufacturer, for each customer of the central station is a continuing customer and the source of continued profit and revenue, whereas to the manufacturer each sale is a transaction complete in itself.

Altogether, a movement having such useful and beneficial aims should receive the generous support of all in the industry, at least until such time as the soundness of the idea can be tested, and particularly of those branches of the industry which are obviously most likely to receive the most immediate returns from the movement.

Birmingham Meeting of British Association for the Advancement of Science.

The British Association is to meet this year at Birmingham, England, from September 10 to 17, under the presidency of Sir Oliver Lodge, the principal of Birmingham University.

The following meeting of the Association (in 1914) is to be held in Australia, and it is probable that a very large number of members and associates will rally at the Birmingham meeting on this account, since not many can be expected to spare the time or to afford the cost demanded by a six months' visit to the Antipodes. Last year at Dundee, over 2,500 members and associates were enrolled, and it would not be surprising if this total were exceeded at Birmingham.

The inaugural meeting will be held in Central Hall, on September 10, at 8:30 p. m., when Sir Oliver J. Lodge will assume the presidency, in succession to Prof. E. A. Schafer, and will deliver an address.

Following are titles of some of the papers with their authors that appear on the provisional program of Section A (Mathematics and Physics) and Section G (Engineering):

Section A.—Presidential address, H. F. Baker; "Nature of X-Ray," Professor Barkla; discussion on radiation, J. H. Jenns, A. E. Love, E. Rutherford, S. B. McLaren, E. Pringsheim; "Lightning and Protection from it," Sir J. Larmor; "A New Method of Starting a Mercury-Vapor Lamp" and "A New Method of Sealing Electrical Conductors through Glass," J. S. Anderson; "A Direct Method of Measuring Magnetic Susceptibility and Instruments for this Purpose," W. H. F. Murdoch.

Section G.—Presidential address, Gisbert Kapp; "Reconstruction of Snow Hill Station, Birmingham," Messrs. Gleadow and Shackle; "Some Effects of Atmospheric Conditions on Wireless Signals," Professor Marchant; "The Nature of Electromagnetic Waves Employed in Radiotelegraphy and the Mode of their Propagation," Professor Howe.

Boston Edison Energy Growth.

Besides supplying customers direct, the Boston Edison Company sells electricity to other companies and municipalities, the volume of sales for three years past being:

Sold to	Number of Kilowatt-hours. 1912-13.	1911-12.	1910-11.
Cambridge Electric Light Company	8,116	8,035	4,059
Charlestown Gas and Electric Company	1,927,957	1,804,794	1,483,538
Town of Norwood	1,597,600	1,136,000	664,950
Town of Wellesley	573,970	521,140	501,810

The increase in the business of the company has been extraordinary. Starting in 1886, the gross earnings for the year were $21,580 on $100,000 capital. In 1888 the gross earnings had increased to $121,000; during eight years following they increased 500 per cent, in the next ten years nearly 400 per cent and in the past five years 50 per cent.

The company had 90 customers in 1886, and 4,000 more at the end of eight years, while in 1904 the number of customers was 19,000.

Fire at Spirit Lake.

The electric light and power plant at Spirit Lake, Iowa, was destroyed by fire on July 20.

New Swiss Hydroelectric Station.

Work is in progress for constructing a powerful hydroelectric station in the Valais, French Switzerland, which will utilize what is claimed to be the highest fall in the world. It will be in the Rhone Valley, and supplied by water from Fully Lake, about 5,360 feet above.

There will be a conduit 2.8 miles in length, composed of pipes from 19.5 to 23.5 inches in diameter, with walls 0.25 to 1.75 inches thick. At its lower end, which will have to resist a working pressure of 165 atmospheres, the conduit will be formed of weldless drawn-steel tubes. The machinery will include four turbines of the Pelton type, developing 3,000 horsepower at 500 revolutions per minute. These turbines are being provided with interchangeable blades of forged steel fitted on the rim of a disk, also of forged steel, by a special method, and designed to withstand the shocks of a jet with a velocity reaching 175 meters (574 feet) a second, while permitting easy replacement of the blades in case of wear. The conduit tubes are supplied by a German firm, and the turbines are being built by a Swiss company in Geneva.

This is part of a system of hydroelectric development in Switzerland, encouraged and promoted by the Federal and Cantonal Governments, which control and conserve the natural resources of the country, especially the water power, which constitutes an important asset in the industrial affairs of the Swiss Confederation.

German Manufacturers Will Also Make High-Candlepower Half-Watt Tungsten Lamps.

Almost simultaneously with the announcement made by the General Electric Company of the perfection of methods for the making of high-candlepower drawn-wire tungsten lamps with the extremely good efficiency of about one-half watt per candlepower, comes a similar announcement by German electrical manufacturers. In commenting on this, *Electrical Engineering*, of London, England, states that although it is likely that a metal filament lamp with an efficiency of about a half-watt per candle will be placed on the market in the autumn, it need not cause any unrest in the mind of the central-station engineer who is anxious not to lose any of his lighting load, or of the contractor who will shortly be ordering his autumn stocks of lamps. The half-watt lamp, when it makes its first appearance, will certainly be no smaller than 1,000 candlepower; probably a start will be made by the Allgemeine Elektricitäts-Gesellschaft, of Berlin, with a 5,000-candlepower, 2,500-watt lamp, suitable for 110 and 220 volts, and the 3,000, 2,000, and 1,000-candlepower sizes will follow later. The lamp has a drawn tungsten filament, which is subjected to a special treatment after drawing. The 5,000-candlepower lamp will doubtless compete strongly with arc lamps for street lighting, and still more strongly for the lighting of large interiors, if the estimated life of from 1,000 to 1,500 hours is attained.

The Deutsche Gasglühlicht Aktiengesellschaft (the owner of the Osram lamp patents in Germany) is also developing a lamp on similar lines. This will also only be for very high candlepowers at the outset—1,000 candlepower and more—and in this case possibly for voltages below standard.

It is seen that the announcements and comments that have been made in the press with regard to the half-watt lamp—suggesting that this lamp will invade the market in its millions, and be taken up rapidly by contractors and the public, and that the central station engineer will have to seek consolation in the fact that there are other uses for electricity than for lighting—are all based on incomplete information. No panic is necessary, and the enthusiasm is premature; all that will happen in the immediate future is that arc-lamp manufacturers will have to prepare for even more serious competition than hitherto from the metal-filament lamp.

Interesting Use of Aluminum Creates Demand for Induction Furnaces in India.

According to the report of an American consular officer in India, there is in that country a rapidly increasing use of aluminum ware for water vessels, cooking utensils, etc.

In the opinion of A. E. Chatterton, director of industries and commerce of the State of Mysore, who has given much attention to the promotion of the aluminum-working industry in southern India, great encouragement would be given to a wider establishment of small plants for working aluminum ware if small electric induction furnaces of, say, 10 to 20 pounds capacity for melting the aluminum could be introduced there, and Mr. Chatterton, whose headquarters are at Bangalore, Mysore Province, would be glad to hear from any American manufacturer who might be willing to supply such furnaces at reasonable cost. If suitable furnaces could be introduced, the governments of southern India would doubtless be willing to co-operate to encourage their sale, government hydroelectric energy being available at reasonable rates.

As the demand for aluminum ware in India promises to increase faster than the local establishments for working it can keep pace, there seems to be an existing opportunity for American manufacturers of aluminum to sell in that market not only the raw material of ingots and sheets but also finished articles, such as water-carrying vessels and cooking utensils. These would probably have to be fashioned to suit the native tastes, however.

German Wireless Telegraphy in Africa.

In the course of the past year the telegraph department in the various German protectorates in Africa have established wireless telegraph stations, which will maintain general communication between the coast and vessels at sea, as well as among the wireless stations themselves. Such stations have been erected already in Swakopmund, Lüderitzbucht and Duala, Kameroon. Lome, in Togo, has long had such a station. Between Swakopmund and Lüderitzbucht communication at any time is possible, and also between Lome and Duala. Messages have been already exchanged between Swakopmund and Duala, but only under very favorable conditions. The important problem of the immediate future is, by increasing the power of these two stations, to establish certain telegraphic communication between the colony and Kameroon and that of German Southwest Africa. As soon as that has been effected, the German colonies on the west coast of the Dark Continent will be in wireless communication with each other.

In German East Africa, Daressalam will have a wireless station next year. Muansa, on the southern shore of Lake Victoria, and Bukoba, on the western bank, already have such stations, and the range of that at Muansa puts it in touch with the East African coast. These inland stations will be intermediate connecting links between Southwest and East Africa, and thus establish wireless telegraphic communication among all German African possessions.

Communication with the Fatherland via Togo and Nauen seems only a question of time. This will make Germany independent of all other countries in her communication with her colonies. Such connection with East Africa will very soon be an established fact.

Colorado Coal Production.

Coal mining as an industry in Colorado began in 1864, when a production of 500 short tons was recorded. In 1876 the production reached for the first time a total exceeding 100,000 tons, and six years later, in 1882, it had reached the million ton mark. Since that date the increase has been almost uninterrupted. The production exceeded 3,000,000 tons in 1890; 10 years later it had grown to over 5,000,000 tons, and in 1910 it exceeded 11,000,000 tons, but in 1912 it fell below the 11,000,000-ton mark.

Electricity in Piano Factories.

The space economy of motor drive, the reduction in fire risk and the increased production with lower power costs are a few of the advantages that apply specifically to piano factories. As comparatively small amounts of wood waste are produced this question does not affect the economy of purchased power.

Insofar as the advantages of electric motor drive are concerned, piano factories do not differ from other woodworking plants, increasing numbers of which have superseded their old systems of mechanical transmission with the more modern methods of drive. From the central-station standpoint, however, the fact that the amount of wood refuse produced is smaller in piano factories than in other woodworking establishments, is an important item in soliciting this class of business. As is readily appreciated, lumber of the highest grade is used in the manufacture of pianos and naturally more attention is given the subject of waste than in a sash and door plant or box factory, handling cheaper grades of wood. Also the rate of production in a piano factory is proportionately reduced due to the large volume of work necessary on a single instrument. For a given machine equipment, therefore, the amount of wood waste in a piano factory will be less than half that of a box factory or other similar woodworking plant.

Two Motors Belted Direct to Woodworking Machines in Piano Factory.

However, the question of wood waste is being successfully solved in numerous plants. Actual experiences of a number of piano manufacturers indicate that a ready market can be found for all waste in excess of that burned to supply steam for dry kilns and heating in winter, and where the income from this is not sufficient to pay the entire power bill—as it is doing in some cases—it reduces the cost of central-station power to a figure that makes isolated-plant costs prohibitive in comparison.

The specific advantages of motor drive in piano factories are space economy, reduced fire risk and increased production at lower power cost, where central-station power is purchased.

Due to the size of the product manufactured and the necessity for considerable storage space, any method of drive that will economize on the amount of floor space essential to actual manufacture should appeal to piano manufacturers. The direct application of electric motors to woodworking machines has been successfully solved by machinery and motor manufacturers and it is now possible to lay out an installation with individual drive exclusively, thus effecting a considerable saving in space. The relative merits of group and individual drive must, however, be determined in every instance by a careful analysis of the requirements of the installation, and while group drive may answer in many cases, it is now the consensus of competent opinion that in a large majority of cases the highest efficiency both for the machinery to be driven and for the elec-

trical equipment, can best be obtained by the application of a separate motor to each unit.

There are other conditions that have an important bearing on the selection of drive for piano factories that should be given due consideration. In modern establishments, high productive capacity will hinge largely on the convenience and rapidity with which work may be handled. Therefore, costly high-speed tool equipment may fail to realize possibilities unless the machines be installed with independence of the usual fixed lineshaft conditions. In shops where productive machines are widely separated, one from another, or where occasional machines must be reached by long lines of shafting, individual drive is vastly more economical and generally preferable. Also, if metered-power costs are to be low, it is axiomatic that motors be operated so as to give a high running load-factor, that is, the input should approach full-load values during any period of time the motor is in circuit. This condition is manifestly difficult to attain except with individual drive, where the power may be shut down instantly with cessation of productive work.

Regarding fire risk, if power is obtained from an adjacent steam plant the fire risk is great and insurance rates correspondingly high. Mechanical drive necessitates either the dangerous proximity of the boiler room or heavy losses in long steam mains or rope transmission. If central-station power is used, all danger from adjoining power plant is removed.

Selection of Motors.

The selection of the proper motors for driving woodworking machines used in piano factories is of the utmost importance and should be given the proper consideration by power engineers. If only direct-current supply is available, motors should be compound wound or of the inter-pole variety, since it is absolutely essential that the motors be capable of resisting the inherently excessive peaks which are apt to occur during the all-day load of the great proportion of woodworking machinery. Direct-current motors should be totally inclosed, except in those special cases where the driving machines are ceiling-suspended away from shavings and sawdust or located in a separately partitioned room, in such manner as to eliminate fire risk.

Large motors should be artificially ventilated and supplied with piping to and from outlet-openings (1.5 cubic feet of air per minute per horsepower is usually sufficient). All controlling appliances of whatever nature, if exposed to sawdust and shavings should be totally inclosed.

Where alternating-current supply is available, the polyphase induction motor with high-resistance squirrel-cage rotor should be specified, since the high-resistance rotor permits quick and frequent acceleration and provides the heavy starting torque required to overcome the inherently great inertia of woodworking machines. The type of alternating-current polyphase motors with polar-wound rotor and internal starting resistance, while possessing admirable torque and starting current characteristics, is not generally recommended for woodworking machines since sawdust almost invariably may be expected to collect on the starting resistance. In a few cases where variable speed with electrical control is desired, polar-wound internal-resistance rotors with collector rings and external resistances may be used. However, specifications should call for inclosed collector rings.

Since direct-current motors must be inclosed, their ratings for such operation must be sensibly diminished and larger machines are therefore demanded. In those few cases where variable speed is desired for operating the feed, alternating-current motors may be used of either the adjustable or multi-speed type. Woodworking plants are usually situated in the outskirts of the city, where the central station ordinarily supplies alternating current. The problem, therefore, of supplying breakdown service is much simplified.

Owing to the high speed and light moving parts of woodworking machines and the frequent violent application of the load, it is desirable to use belt drive rather than gears or chains, especially as the speed of the driven pulley is usually too high to permit of other than direct or belted connection. The direct drive is coming into vogue in many modern piano factories and is giving excellent results where the motor has sufficiently generous rating to accelerate rapidly and to withstand overloads. As the average depreciation of belting averages 36 per cent per year, it is important to reduce this waste and furthermore do away with any

10-Horsepower Motor Belted to Two Line Shafts.

15-Horsepower Motor Direct-Connected to Molding Machine.

Piano Manufacturing Data—Sheet No. 1.

The term load-factor is used in these data in such a sense that a load-factor of 100 per cent represents the use for 24 hours every day of power corresponding to the rated capacity of the motors connected. An operating-time load-factor of 100 per cent represents the use of the rated capacity of the motors for the running hours per day specified for each installation.

Shulmann Piano Company, Rockford, Ill. This plant manufactures complete pianos, buying the actions from another firm. The shavings and scrap lumber are used for fuel in a boiler which heats the building and supplies a steam fire pump. There are 150 men employed working 10 hours per day. The output is 6 pianos per day.

Total connected horsepower, 182. Total number of motors installed, 35. Average kilowatt-hours per month, 10,170.

Kilowatt-hour consumption for 12 months: January, 11,500; February, 10,900; March, 10,750; April, 10,870; May, 9,980; June, 8,650, July, 9,540; August, 9,980; September, 7,510; October, 10,170; November, 10,670; December, 11,500.

Load-factor, 12 per cent; operating time load-factor, 21 per cent.

The approximate electrical energy per piano made is 65 kilowatt-hours.

MOTOR INSTALLATION.

The following is a list of the motors installed with their respective drives. The supply source is three-phase, 60 cycles, 220 volts. All motors are of the squirrel-cage induction type.

No.	Horse-Power.	Speed R. P. M.	Application.
1	5	1,700	Belted to a countershaft of a Dodds 16-inch single cut-off saw, 2,040 revolutions per minute.
1	5	1,700	Belted to a 16-inch rip saw.
1	5	1,700	Belted to a two-hanger shaft driving two 16-inch rip saws, 2,550 revolutions per minute.
1	5	1,700	Belted to a F. H. Clement 24-inch single surfacer.
1	5	1,700	Belted to a F. H. Clement 16-inch jointer.
1	5	1,700	Belted to a B. D. Whitney 27-inch jointer.
1	10	1,700	Belter to countershaft of a Fay & Egan No. 217 glue jointer.
1	3	1,700	Belted to a two-hanger vertical shaft driving one boring machine.
1	5	1,700	Belted to a countershaft of a Berlin 18-inch double cut-off saw.
1	10	1,700	Belted to a H. P. Smith No. 447 sash sticker, four heads, 10.5-inch knives.
1	3	1,700	Belted to countershaft of a Buss double-spindle shaper.
1	3	1,700	Belted to a Fay & Egan 36-inch by 0.25-inch band saw.
1	3	1,700	Belted to countershaft of a six-inch pattern lathe.
1	10	1,700	Belted to a B. D. Whitney 30-inch scraper. Scrapes 75 feet per minute, nine rolls.
1	3	1,700	Belted to countershaft of a B. D. Whitney scraper-knife grinder.
1	3	1,700	Belted to a two-hanger shaft driving two fans.
1	2	1,700	Belted to a two-hanger countershaft driving a Frances No. 25 glue spreader, 51 revolutions per minute.
1	0.5	1,120	Belted to a countershaft on a 12-inch by 16-inch glue roller, 50 revolutions per minute.
1	1	1,120	Belted to countershaft of an N. J. Bielstrom glue clamp.
1	3	1,700	Belted to a 24-inch by eight-inch single-spindle sander, 830 revolutions per minute.
1	3	1,700	Belted to a countershaft of a four-inch by 12 inch single-spindle sander, 3,400 revolutions per minute.
1	40	1,700	Belted to a Sturtevant 55-inch blower.
1	3	1,120	Belted to an Allen 36-inch by 0.25-inch band saw.
1	0.5	1,700	Belted to a six-inch emery wheel.
1	2	1,700	Belted to a H. B. Smith eight-inch post sander.
1	5	1,120	Belted to a Maddox stroke sander, rubber and polisher.
1	5	1,120	Belted to an eight-inch belt sander, 10 feet between sanders and pulleys.
1	3	1,120	Belted to a 36-inch by 0.25-inch band saw.
1	5	1,120	Belted to a three-hanger countershaft driving one 36-inch grind-stone, 84 revolutions per minute; and one 12-inch cut-off saw.
1	1	1,120	Belted to countershaft of a boring machine.
1	5	1,120	Belted to driving mechanism of a 4,000-pound elevator.
1	5	1,700	Belted to a countershaft driving a machine for planing backs of pianos, has one vertical knife seven inches wide.
1	3	1,700	Belted to a boring machine.
1	2	1,700	Belted to a two-hanger countershaft driving one 16-inch by one-inch carborundum wheel, 340 revolutions per minute.

Piano factory. Total connected horsepower, 34.5. Total number of motors installed, 9. Average kilowatt-hours per month, 290.

Kilowatt-hour consumption for twelve months: January, 235; February, 101; March, 158; April, 201; May, 264; June, 343; July, 222; August, 194; September, 281; October, 215; November, 365; December, 270.

Load-factor, 1.6 per cent.

MOTOR INSTALLATION.

The motors installed in this plant are squirrel-cage induction machines, two-phase, 60 cycles, 220 volts.

No.	Horse-Power.	Speed R. P. M.	Application.
1	7.5	1,120	Belted to countershaft of a Rowley & Hermance four-head, eight-inch molder.
1	10	1,120	Belted to the countershaft of a Lehman Machine Company four-side, 24-inch planer.

Piano Manufacturing Data—Sheet No. 2.

1	3	1,700	Belted to an 18-inch rip saw.
1	2	1,700	Belted to a Rowley & Hermance 16-inch jointer.
1	2	1,700	Belted to a countershaft of an 18-inch swing cut-off saw.
1	1	1,700	Belted alternately to a Rowley & Hermance 36-inch band saw, and countershaft of an M. B. Cochran & Company four-head, four-inch tenoner.
1	1	1,700	Belted to a three-foot countershaft (two hangers) driving one 10-inch double emery wheel, and one 24-inch grindstone.
1	3	1,700	Belted to a 10-foot line shaft (two hangers), driving one Levi Houston jig mortiser; one Grand Rapids Sash Pulley Company three-tool boring machine; one 22-inch pattern lathe; one Cordesman two-head pony molder.
1	5	1,700	Belted to a shaft driving one Rowley & Hermance 18-inch cut-off saw; one F. H. Clement single-spindle shaper.

Piano factory manufacturing piano actions only. There are 180 men employed working 10 hours per day. The output of the plant is 30,000 piano actions per year.

Total connected horsepower, 125. Total number of motors installed, 8. Average kilowatt-hours per month, 11,490.

Kilowatt-hour consumption for 12 months: May, 16,000; June, 17,300; July, 14,600; August, 14,200; September, 9,000; October, 6,900; November, 8,600; December, 8,300; January, 9,000; February, 10,500; March, 11,500; April, 12,000.

Load-factor 16 per cent; operating-time load-factor, 35.3 per cent.

MOTOR INSTALLATION.

The following is a list of the motors installed with their respective drives. The supply source is three-phase, 60 cycles, 220 volts. All motors are of the squirrel-cage induction type.

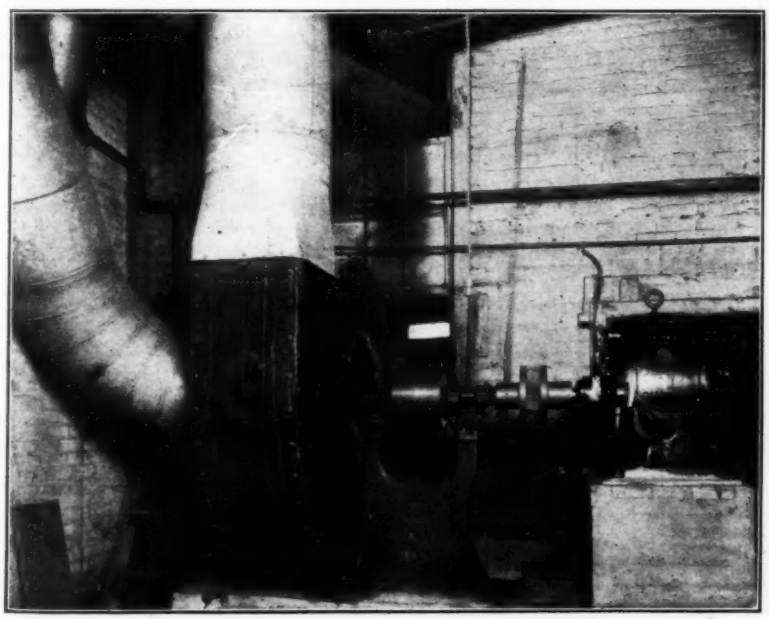
No.	Horse-power.	Speed R. P. M.	Application.
1	20	710	Belted to an American steel-plate double 40-E exhauster.
1	7	700	Belted to a 20-foot shaft, four hangers and three two-hanger countershafts driving one Berlin No. 225 12-inch rip saw, 4,000 revolutions per minute; one Falls Machine Company tool grinder 10-inch by 0.25-inch stone; one Goedell & Pratt double emery wheel; and two William Menge automatic needlers.
1	15	710	Belted to an American steel-plate double 30-E exhauster.
1	7.5	710	Belted to a 90-foot shaft, 10 hangers and four two-hanger countershafts driving one William Menge 10-inch rip saw; one H. B. Smith three-head four-inch molder; two Pyribil 10-inch rip saws; and one William Menge four-inch cut-off saw.
1	7.5	710	Belted to a B. F. Sturtevant 40-inch exhaust fan.
1	25	720	Belted to a 125-foot line shaft, 20 hangers, and nine five-foot two-hanger countershafts driving four Hansen & Van Winkle No. 3 double emery wheels; one small speed lathe; one W. F. & J. Barnes 20-inch drill; one three-spindle drill; one D. F. Sturtevant 30-inch exhaust fan; three G. H. Walker four-inch cut-off saws; five William Menge four-inch cut-off saws; and two Wysong & Miles belt sanders, belts two inches to six inches wide, speed 2,100 feet per minute.
1	3	1,400	Belted to a 40-foot shaft, nine hangers, and seven two-hanger countershafts driving two A. H. Nilson horizontal boring mills; three William Menge speed lathes; one William Menge three-inch cut-off saw; and one William Menge sticker.
1	40	720	Belted to a 170-foot shaft, 34 hangers, and three two-hanger countershafts driving two G. A. Walker four-inch cut-off saws; one shank roller; four wooden tumbling barrels, 12 inches by 36 inches; one Baldwin metal drill; two Nilson boring machines; one Nilson "sticker" boring machine; one William Menge siding-off machine; one William Menge flange-boring machine, four spindles; one Menge flange-boring machine, two spindles; one A. H. Nilson damper block; one Menge boring machine, three spindles; one Menge damper-boring machine, four spindles; one Frazer butt machine, five spindles; two Menge fly-boring machines, three spindles; one butt frazing-out machine; one fly siding-off machine; one A. H. Nilson butt-boring machine, five spindles; one A. H. Nilson button maker, three spindles; one A. H. Nilson spring rail-boring machine; one Menge Dowell borer, two spindles; three Menge flange borers, four spindles; two Menge tongue borers, four spinldes; one Menge fly-flange borer, two spindles; two A. H. Nilson regulating rail borers, two spindles; two A. H. Nilson action rail borers, four spindles; one American Blower Company double 35-inch steel plate exhaust fan, 1,550 revolutions per minute; one A. H. Nilson shank machine; one Pyribil 10-inch single-head molder; one 10-inch rip-saw; one eight-inch rip-saw; one 10-inch single-head molder; one four-head eight-inch molder; one 12-inch jointer; one American 14-inch swing cut-off saw; one Berlin 10-inch rip saw; one American 22-inch jointer; one 40-inch by two-inch band saw; one double emery wheel 10-inch by one-inch; and one 1,200-watt plating generator.

20-Horsepower Direct-Connected to Planer.

source of slippage between the driving unit and the working pulley.

Improper mechanical connection between motor and machine or motor and countershaft has in some instances caused unjust criticism of motor drive. For direct connection a flexible coupling should be used unless motor and machine are mounted on a common metal bed plate or the motor is attached to the frame of the machine. Most manufacturers of modern woodworking machines have so designed them that they can be readily adapted to individual motor drive. Chain drive or heavy belt with a spring belt-tightener is desirable when the motor must be located close to the machine but cannot be direct-connected.

Conditions relative to the application of electric motors in piano factories can best be pointed out by a brief description of the plant of the Schumann Piano Company of Rockford, Ill., which purchases power for all of its requirements from the Rockford Electric Company. About eight years ago this company moved into a building which was formerly occupied as a chair factory and until recently the old engine and shafting were used by the Schumann Company.



25-Horsepower Motor Driving 50-Inch Fan.

Owing to the increased demand for high-grade pianos the management decided to greatly increase the capacity of the plant. The question of power arose, and in going over the old plant and shafting it was found that the entire plant would have to be remodeled in order to have an up-to-date factory. With the old arrangement the machines were scattered around the large mill room with no view to having each machine in the most convenient place.

A little skeptical at first, the management was soon convinced that central-station power at a reasonable figure per kilowatt-hour would admit of a more systematic arrangement of machines and save at least 10 per cent of the cost per hour, even with the dry kilns to supply with steam. In laying out the reconstruction of the plant, consideration was given first to routing the raw material through the factory; second, to the convenient location of the switches and auto-starters, and third, to the motor location in order to save floor space and reduce the number of belts. In all, 177 horsepower of squirrel-cage induction motors were installed, ranging in size from 0.5 to 40 horsepower, according to the requirements of the machine, most of them being located on the rafters, near the ceiling, and driving through the floor to the machines located on the floor above. Practically all of the belts are covered by wooden troughs, or so inclosed as not to endanger the workmen.

In addition to these motors, electric glue pots have been installed, and have proven more than satisfactory, inasmuch as they have displaced over 600 feet of steam piping and saved considerable time by having the glue at the man's side ready for immediate use, where before it was necessary for the workman to walk to the center of the room for his glue, a distance in some instances, of over 50 feet. The wiring is protected with iron conduit wherever there is a possibility of mechanical injury, and all meters, main switches and current transformers are located on the side walls, in a cabinet, which allows free access when opened.

The present electrical equipment has made a remarkably large saving in space and has done away with over 1,000 feet of shafting. By studying the requirements, the engineer who laid out the new installation was able to place the machines in such a position that now the wood comes from the dry kilns and passes from one machine to the next until it is ready for the different departments. Formerly, when the machines were placed where they were most convenient to the shafting, it traveled about the mill room several times.

The cellar was at one time a mass of shafting and belting, which has now been removed and the entire basement has

been added to the factory as available floor space. It is the intention of the management to have trucks drive into the cellar and unload directly into the elevator, and in this way facilitate the handling of material.

When working up the data, one thing was especially noticeable; namely, that at least 75 per cent of the machines were operating at less than normal speed. These speeds were brought up to the normal, thus materially increasing production.

This plant has been operating with motor drive nearly two years, and is running well within the original estimate of power consumption and dry-kiln heating. The waste wood is amply sufficient to furnish fuel so that 60 pounds of steam can be carried for the fire pump and dry kiln during the day, and in addition to the offal, the night watchman uses a thousand pounds of coal to carry him over the night. The dry kiln is 72 by 22 feet, with a capacity of 3,600 feet of lumber.

The following points have been demonstrated in this woodworking shop: the initial cost of increased power secured from a central station is less than the installation of a steam plant and shafting; a great gain in floor space has been made, and the operating cost compares favorably with the best isolated plant figures. One thing that might be of particular interest to the power man is that the offal in this shop is small—practically nothing when compared with regular woodworking establishments.

Commercial Practice
Management, Rates, New Business

AN ANALYSIS OF SOME COMPLAINTS AND GRIEVANCES OF CENTRAL-STATION CUSTOMERS.

By A. R. Cordner.

There are few of us who, either in adjusting bills or making investigations and tests on account of complaints, have not been told by some irate complainant that he would install his own plant, place a gas engine, or discontinue his electric service the minute his contract expired. The customer may be sincere in his declaration or he may not be (very probably he is not) but his feelings in the matter are very strong and he should be listened to and the cause of his dissatisfaction learned. Such a man is often very quick to accept an explanation when it seems conclusive, or even plausible, and it is the duty of the central-station employee or representative on the premises at this critical time to use his best efforts in pacifying the customer, or at least getting him into such a state of mind that he is willing to withhold a decision until the matter is investigated and taken up by the proper authorities.

There are many instances where such complaints are made to the first representative of the company who appears and a promise is made that the trouble will be reported to the office and attended to promptly. Then the representative promptly forgets the matter.

It is just here that a chance to set the company right is either taken advantage of or lost, as it must be admitted that the man to whom the customer makes his complaint is considered a part of the company and his conduct and actions a reflection of the company policy. More than likely the customer's remarks will be either prefaced or ended with a general condemnation of corporations, and the writer has invariably found it a good plan to express his own confidence in the methods and aims of his employers, always remembering that a rebuke to the machinery of his company is a rebuke to all its individual parts, including himself; and therefore, knowing that the entire organization from the president down to the most humble servant would resent any inference to his dishonesty, it seems natural that such a realization would be an effective weapon with which to meet his antagonist at the outset.

Such a stand will often nonplus a man, who very likely considered the employee in the light of an unfortunate victim, as he sees himself. There must be some particular grievance which is being nursed, some methods which are objected to, or any one of a hundred different causes for dissatisfaction. It will often become apparent in some such question as this: "If what you say is true and your concern wishes to treat us squarely, why did they do this, or why did they not do that?" We now have a wedge with which we can enter the very often imaginary structure of wrongs and it is up to the man on the job to drive it home—now.

If definite adjustments cannot be made at the time,—if the inspector or solicitor has not the authority to take the matter up thoroughly,—the consumer is at least in the frame of mind to hear our explanations when given by the proper person.

Let us next consider the common causes of complaints in general, and in order to do this we will divide our customers into two classes: the habitual "kicker," and the man who at very great intervals, or perhaps once in our dealings with him, makes a definite and dispassionate remonstrance.

In the first class is usually found the antagonist of all public-service corporations. He will perhaps start his remarks with the assertion that he is the victim of monopoly and lack of competition, and that he has no redress but must pay his bills, although unjust. Furthermore, his meters are invariably wrong. They are fast, it is impossible to accurately measure electrical energy, and so forth.

These are arguments easily met by the average service-company employee. Those familiar with our product are aware that the larger the company grows, the more it expands, the more diversified its business becomes, the less it costs to produce our product. The results of these conditions, this monopoly, to term it thus, have been —in the history of nearly all large and small central stations throughout the country—voluntary reductions in rates, reductions in the price of lamps, more advantageous contracts or other concessions to the consumer.

Assuming that the reverse was true, that natural growth has been accompanied by increased rates and so forth —assuming this, just for the sake of argument and to illustrate a point—would this be a wise reason for installing a private plant, when this plant is undoubtedly going to be more expensive than purchased power? Is not such a procedure simply selecting the greater of two evils?

With reference to those who look upon the meter as a device which at all times should be suspected as more likely

to favor the producer than the consumer, the writer believes that this idea can in nearly all cases be dispelled to the entire satisfaction of the consumer if the meterman will go to the trouble to thoroughly explain the theory and operation of the meter and not treat the matter with an air of mystery. There should be no mystery about the measurement of power, no good reason why any competent employee could not entirely satisfy the average intelligent person as to the accuracy and reliability of his meter. People are generally under the impression that such instruments are much less expensive than they are, very likely to have never seen the inside of the case of such a piece of apparatus. When the investment necessary to meter the energy supplied a customer is mentioned, the expenses of caring for, testing and so forth are made known, and furthermore the fact that the same meters are made use of in the stations of the company as the authoritative reports upon which their costs of production are figured, the customer's respect for the apparatus begins to increase, and a careful demonstration and explanation of the mechanism and action of the meter will very probably dispel any doubt left. It is also a good plan to carry a copy of stringent meter specifications; say a state commission rule or part of the National Meter Code or such authoritative demonstration of accepted accuracy and reliability.

There are various ways in which the accuracy of registration may be proved; for instance, after carefully calibrating the meter the customer can be instructed in the reading of an indicating instrument in which there is generally more confidence placed. The load on the instrument and so on the meter can then be varied and the wattage computed from the revolutions of the disk by the party demonstrating and the results made known, which will of course coincide with the reading of the instrument being read. This is especially effective when used with large lighting units such as the bigger sizes of tungsten lamps, the close approximation of the readings taken to the rated wattage of the lamp or group of lamps being very effective.

Another habit with the "kicker" is addicted to is the comparing of his bills or rates with his competitors or neighbors. He will very often, without ascertaining or considering any logical reasons for the same, complain because his neighbor has received a smaller bill than himself for some particular period or because his friend in the next block is enjoying a somewhat lower rate, not considering for one minute that his friend's plant is three times as large as his own and that he himself would allow his customer better terms on very large orders.

A certain engineer belonging to this class had a service introduced for emergency purposes. He was operating a plant of considerable proportions and desired outside current in case of breakdown or when the demands did not justify him in operating the plant at night. Sometimes there would be no registration on his meters for a period of two or three months and then something would happen, causing the necessity of using the street current. Every time this happened there was objection to the amount of the bill. When investigations were made, nothing could be found which would justify a complaint. The hours the service was used and the load used were obtainable from records of the engine room, and a comparison always proved the consumption of current correct. The man himself became known to the central-station employees who visited him from time to time as a disagreeable party to handle, being abusive, sarcastic and unreasonable. At last in an attempt to adjust a complaint he was asked point blank, inasmuch as he undoubtedly used the amount of energy he was billed for and that he was aware of it, what kind of imaginary injury from the office he was suffering. It proved to be the matter of rates. There was an unwarranted discrimination. There was a neighboring plant with the same sort of service but a rate of two cents per kilowatt-hour less was being given. Upon investigation it was found that this latter plant differed considerably from the first. Their service was more desirable as a load for several reasons. In the first place the conditions of its use made it a strictly off-peak proposition and furthermore it was made use of more uniformly throughout the year. When these points were submitted to our first consumer and explained fully, although unwilling to admit his error in not ascertaining the facts in the case, it was conceded that the discrimination was justifiable and there was no further complaint.

Other types of the "regular" are the mill of factory manager who complains periodically every busy season, the householder who has been away for the summer, and the electric-fan users. The first of these is the most difficult to handle and also the source of the greatest revenue. In a great many classes of business the busy season is known to all and in the others it is well to become acquainted with the seasons of the year in which the amount of production increases or decreases so that this information can be used to advantage, not depending on the word of the consumer entirely, as he will sometimes apprehend such a question and supply misleading answers. Thus having this information firsthand and knowing just what competitors are doing goes a great way towards making an intelligent investigation of any particular establishment. Again this same party may expect a decrease in-consumption during slightly slack periods, not realizing that the somewhat lesser production is partly compensated for by the low efficiency at which his meters are operating.

The private-house tenant, owing to the uniformity of his bills, will often conceive the idea that his current consumption is for the most part estimated, especially if the meter is read without his knowledge of the reader having called. There have been cases of this nature where the consumer has been away for a period of a week or so and returning, questions a bill and asks for a correction of the same, claiming it absolutely incorrect, as he had the house closed and used no light for two months. This is a difficult situation to handle and it sometimes becomes necessary to question a neighbor in order to disprove the assertions of the customer. A situation of this kind requires tact and diplomacy on the part of an employee, and extreme care and patience should be exercised so that no justifiable cause for complaint be given as to the conduct of employees or representatives.

Every spring or early summer there is a great number of alleged big bills where ceiling fans are connected, especially in saloons, cafes and such public places. During the remainder of the warm weather the number of such alleged overcharges is greatly reduced, showiny that the first bill covers that period when the consumer does not honestly realize that he has used his fan to the extent which he really has. In most of these instances, when the period is taken up day by day with a knowledge of weather conditions at hand, these complaints are easily disposed of.

We now come to the second class of consumers, or those whom we seldom see or hear from except to receipt their bills. An attempt will be made to give some examples of specific camplaints, the causes of which were somewhat out of the ordinary, and the manner in which the root of the trouble was reached and an explanation and report satisfactory to the customer given.

A five-housepower motor which had run for a considerable length of time with very little variation in bills suddenly began to consume about ten per cent more current. An investigation was ordered and it was found that the motor, being a two-phase machine of the squirrel-cage type, had been operating on one phase for some time. Tests were made with the motor so operating and the following results obtained with the motor running at full load.

Two phase: *A* phase, volts 220, watts 2240; *B* phase, volts 221, watts 2520; total watts, 4760.

Single phase: *A* phase, volts 220, watts 5280; *B* phase, volts 221, watts 5300; approximate total watts running 5300.

Excess of wattage single-phase over two-phase, approximately 540.

The compressors of a refrigerating outfit in a cold-storage house were operated by an automatic control in connection with a thermostat. This being the case, the motor by which the machine was driven was idle a great deal of the time until the temperature of the vaults reached a certain figure, when the motor would start and so keep the temperature from going higher. At some time during the hot weather this automatic panel became inoperative and the machinery was run directly from the service continually throughout the day and part of the night. This condition of affairs was not made known to the management and complaint test was made on the equipment. It was then that the man in charge of the test noticed that the motor never stopped as he had seen it do before and upon investigation located the cause as cited. It may be mentioned here that the bills of this consumer always ran somewhat higher than those of two other plants of the same nature, owing to the use of city water of a high temperature, while the other places made use of an artesian well and so had the advantage of its greater cooling properties.

A large theater made use of direct current for spot lights, etc., this current being more satisfactory for general stage-lighting effects. The energy was obtained from a motor-generator, the service being alternating current. Upon starting the motor it was found that it operated satisfactorily until it came to speed and the full line voltage was, as it was thought, applied. At that time the main fuse would invariably blow and the motor come to rest. A service complaint was made to the electric company and an examination made. The trouble was located in the starting box, it being found that owing to wrong connections, one phase of the machine was at all times feeding from the low-voltage taps of the autotransformer. Of course the motor, not having attained its actual full speed, was still taking an excessive current, most of this being naturally supplied by the high-voltage phase, resulting in the blowing of large fuses. The proper connections were made and there was no further trouble of any kind.

Many alleged service troubles may be traced to the motors themselves. Often we find a reduction in speed due to rotting of windings and a consequent short-circuiting, resulting from a careless use of oils, which has the effect of softening the insulation, which loosens from the wire when it becomes heated.

Complaints of vaudeville houses can usually be traced to the stage lighting, to some act necessitating an extra use of light or some special electrical effect.

Among the more common sources of high bills among residences or store customers is the use of lamps after they have passed the useful period. It might be argued here that the wattage of the lamps decreases with age. This is true, but it is offset by the fact that the watts per candle increases. It has been found that in many instances, where, for instance, ten or twelve lamps were sufficient when first placed, the number of lamps has been gradually increased to compensate for the decreased candle-power and therefore the current consumption of the lamps, though less in each individual lamp, is considerably greater in the entire installation.

An increase in curent consumption has also been found due to the use of a greater number of lamps than usual after the hangings, or paper, or painting of walls have been changed. This may be readily conceded as a factor when the fact is considered that the amount of reflection of light varies from 82 per cent for white blotting paper to 0.4 per cent for black velvet..

It has been the intention in the present article to point out some of the unusual sources of trouble so that the average employee may realize that for an effect there is a cause, either in fact, or in the personality of the parties with whom he deals. It has also been the intention to emphasize the importance of understanding human nature and learning to handle the various classes from whom our industry derives its revenue.

Belt Accidents and Individual Electric Drive.

A strong argument in favor of the individual electric drive for certain industries is afforded by the number of accidents arising from the putting-on of belts.

Where a number of independent machines, many of which stand idle for a week or more at a time, are driven through shafting, it is customary to keep all belts off except those of the machines which are actually in use. In fact, this is the only efficient method of driving through shafting, as the losses incurred by constantly running a large number of belts and loose pulleys through which power is only occasionally transmitted would be very considerable.

In cases such as these, a separate motor for each machine is undoubtedly the correct solution, both as regards economy and the absence of danger from the putting-on of belts when the machinery is running. That such belts will be put on without slowing down is abundantly evident as, although a considerable number of accidents occur throughout the whole country, they are rare enough in individual cases to make the men careless.

The application of electric driving to old undertakings is a different proposition, as the shafting already exists, while in almost every case the capital expenditure is a serious item, and the installation of separate motors would be at once condemned on the score of excessive initial outlay.

In spite of this drawback, individual motors would probably pay for themselves in a year or two by the saving in power, particularly where old buildings are concerned.

The reduction in the cost of electrical apparatus is continually strengthening the case for the individual drive, and we may hope to see in time the entire elimination of accidents arising from the putting-on of belts.—*The Electrical Review* (London).

POWER BILL CHART FOR A TWO-RATE SCHEDULE.

By E. D. Dreyfus.

The generally accepted practice of today in the sale of electric power is to base the charges on a two-rate schedule. The first element of cost is the capacity required which is ordinarily termed the demand, and the next essential factor the extent to which the demand is used or the actual amount of energy consumed.

A primary charge is made on the basis of a given cost per unit of demand, viz., per kilowatt either measured or estimated, and this charge remains constant as long as the demand remains stationary.

The rate for the energy metered likewise is usually a fixed amount per unit consumed, viz., the kilowatt-hour, and the amount resulting therefrom becomes the secondary charge and is directly proportional to the hours use made of the demand, or in other words, the applied load-factor. Now with different services, localities and systems the derived unit rates for the primary and secondary charges may and often do vary widely. It is often desirable to be able to make ready comparison as to the net results obtaining under different combinations of demand and energy charges and the accompanying chart has been prepared to allow a rapid and convenient graphical determination of the total monthly bill.

The application of the chart will be at once appreciated by following the directional lines as drawn with arrows.

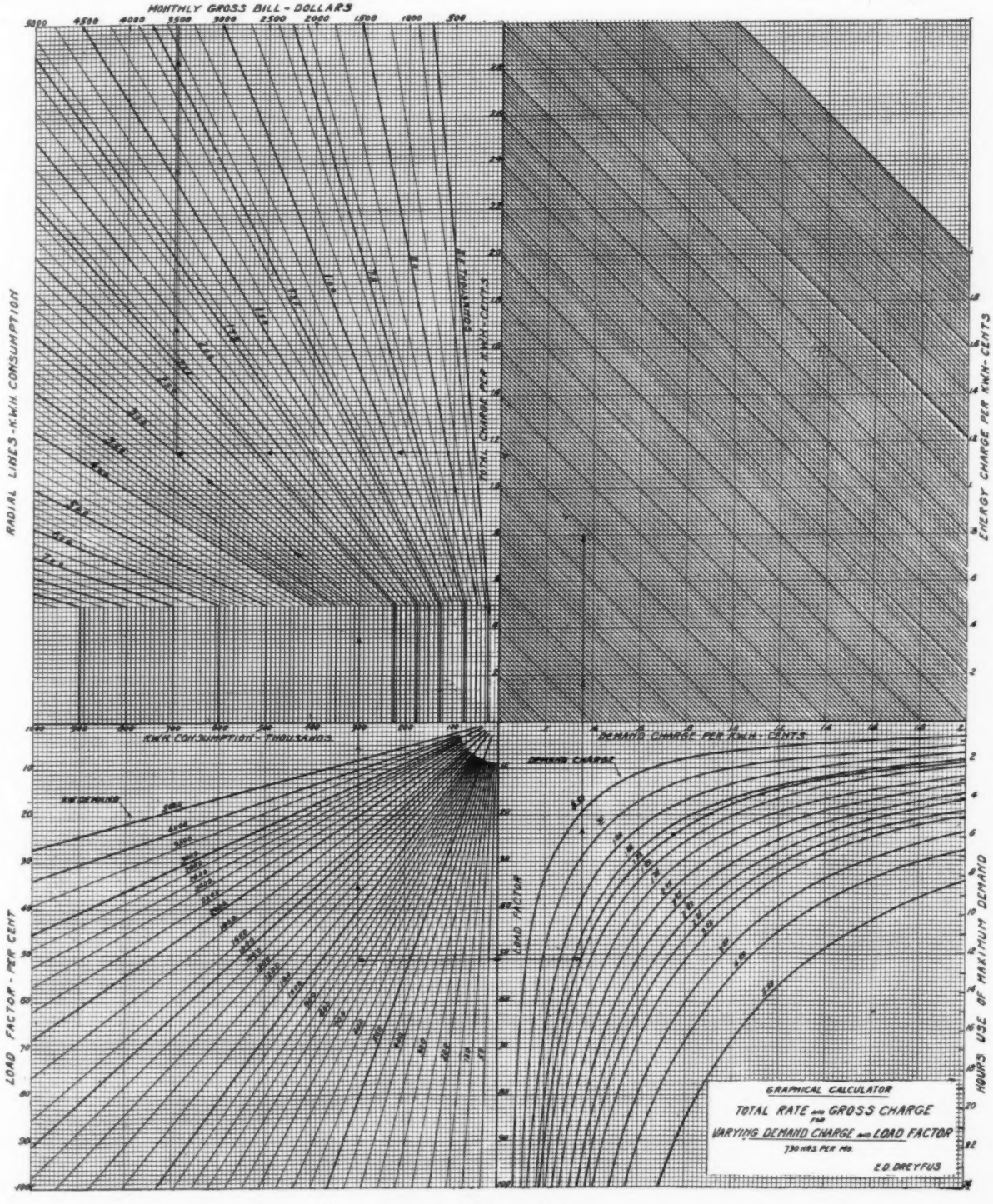
As understood from the aforegoing, there are four conditions involved: (1) the probable demand; (2) the probable consumption according to load-factor or hours use of the demand; (3) charge per kilowatt demand; (4) charge per kilowatt-hour for the energy.

Example.

Assume (1) 800 kilowatt demand; (2) 51 per cent load-factor; (3) $1.33 per kilowatt demand; (4) 0.8 cent energy charge.

Start at 51 per cent on the load-factor ordinate in the lower quadrants and extend on the right to the $1.33 demand curve, and on the left to 800 kilowatt demand. You have thus far obtained the demand charge per kilowatt-hour at this particular load-factor and likewise the kilowatt-hour consumption. At these sections you follow upwardly the vertical ordinates. On the right you continue to the 0.8 cent point on the energy scale and then travel on the 45-degree line which results in an addition of the two charges, or 1.16 cents; and you project horizontally to the left until you strike the kilowatt-hour consumption line as obtained from the demand line in the lower left quadrant.

This chart is so laid out as to permit the use of the index fingers of the two hands to trace the steps virtually simultaneously and to read the final intersection with dispatch.



Graphical Calculator Chart.

Electrical Construction

THE SMALL DEALER'S STORE.

By Richard E. Smith.

Several excellent writers, among them the President of the United States, have in recent publications voiced the opinion that a new era is dawning. It is, they say, the era of a new democracy in which the battles of business will be won by efficiency in industry and not by the outside influence of price-controlling magnates. It is, in short, the little fellow's opportunity—he is to have his chance.

These observations apply particularly to the field of big business—railroads, the steel industry, large manufacturing operations. The man engaged in a small business is apt to say that he cannot help his condition by studying the trend of large affairs. This is because of his tendency to run in a rut. The small business men who are awake to their opportunity are climbing out of the rut and studying the methods of larger concerns, to their material good. Unquestionably the men engaged in the electrical business in a small way can profit by observing the business methods of their big brothers, and it is the purpose of this article and three others which will follow it to call attention to some common faults and suggest simple remedies.

Throughout these articles the term "small city" means one having a population between twenty-five thousand and seventy-five thousand. This size city is selected because here is the small dealer's greatest opportunity. In all cities larger or smaller than the above he labors under the same conditions, in that he is forced to do a neighborhood business. But in a city of twenty-five to seventy-five thousand he can compete in everything in his line and has a large enough field to call out his best efforts. There were one hundred fifty-four such cities in the United States at the last census.

The term "small dealer" as used here means one who does a business of about $2,500 monthly. We will assume that he started out as a wiring contractor, later engaged in making and hanging fixtures and finally opened a little store that serves as headquarters for a three-fold business: contracting, manufacturing and retail selling. It is a typical case.

The small dealer is inclined to bewail his lot, which is rather a happy one if he only knew it. His principal handicap is lack of capital. To offset this are numerous advantages that he holds. First, he is in close touch with his business, his workmen, the men from whom he buys and those whom he serves. If he has any personality he can make it pay dividends here. Second is the fact that many people instinctively seek out the small dealer when making purchases. They feel ill at ease in the large ostentatious places of trade and harbor the idea that they must pay more for their goods if they buy in a large store. Third, the small dealer's mixed business gives him an entering wedge—wiring brings motor and fixture business and both will come back to buy supplies after the installation. The combination of all these conditions enables him to build up a class of trade that is the envy of larger concerns.

Almost any dealer of this class if asked to give his honest opinion will insist upon the following: that the wiring business paid better before he entered the other lines; that makeshift manufacturing of fixtures does not pay, although it sometimes seems necessary; that the sale of supplies is carried on only as a help towards paying the rent; that there are numerous leaks in the business that he could stop if he had the time. He will further declare that advertising is a waste of money and that it is foolish to hire men to care for the store when boys can do as well.

Ask him for a statement of his overhead expense and he will give you something like the following for a monthly business of $2,000:

Rent	$ 75.00
Own salary	100.00
Solicitor-foreman	100.00
Bookkeeper-salesman	75.00
Errand boy	20.00
Fixture man, one-half time	50.00
Telephone, insurance, stationery, etc.	25.00
So-called advertising	30.00
Miscellaneous	25.00
Total	$500.00

This makes a running expense of 25 per cent—altogether too much and yet a very fair average for a business of this size.

If this man will spend one hundred dollars more monthly and spend it all judiciously he should increase his business to three thousand dollars and his statement would be like the following one. Note what items are increased and the amount added to each of these.

Rent	$125.00
Own salary	100.00
Solicitor-foreman	100.00
Lady bookkeeper	60.00
Salesman	80.00
Errand boy	20.00
Fixture man, one-half time	50.00
Telephone, insurance, stationery, etc.	25.00
Good advertising	40.00
Total	$600.00

Here is an overhead expense of 20 per cent, a big improvement over the other. The increased business has come from the improved location that the increased rent will secure, the efforts of a first-class salesman, the pulling power of judicious advertising, and the indirect influence of all these improvements on the character of the store and the merchant.

A glance at the statement shows that rent is a comparatively small part of the running expense; yet it is generally the item that causes the small merchant the most concern. Electric stores as a rule do not pay enough rent; that is to say, by securing a better location, the increased business will invariably overbalance the enlarged item of rent. The electric dealer should have a location as good as the second-class jeweler. He should aim to have a location considerably better than any of his competitors. This can generally be accomplished by watching for a good lease and then sub-leasing a portion to some concern wanting a small room on a good street. This one point of being on the map goes a long way towards success.

Now look at the items of bookkeeper and salesman. Go into almost any store of the kind we are discussing and you will find that the bookkeeper is the principal, possibly the only salesman. Here is a condition that must be remedied. A firstclass salesman is needed and it is safe to say that the bookkeeper cannot qualify. Furthermore, if the bookkeeper is away from his accounts very much, the merchant is going to miss a lot of vital information about his business. The bookkeeper is more than a debit and credit salve—he is the barometer of the business. For $60 a month, one should get a firstclass lady accountant who will devote all her time to the books. In addition to the ledger accounts, she can keep a cost-keeping system that will be explained later, a record of daily sales for each man in the store, a monthly record showing sales of all the important items in stock, as lamps, batteries, irons, toys, etc., and a semi-annual inventory. Records of this sort are as im-

portant to the merchant as a chart is to the mariner. They will help him in determining wages, in buying stock, in advertising, in approaching credit men and in numerous other ways.

Now let the merchant determine to get the best retail salesman he can find; one who wears clean linen and shaves every day. A firstclass man should be obtained for $80, and, given the right backing, his sales should run $30 a day. This man should be selected for his ability to sell rather than for any working knowledge of electricity. If he is the right sort, he will soon acquire enough technical knowledge to enable him to talk intelligently. The dealer should give him entire charge of the retail stock, have him report shortages and listen to his advice about new lines, make him responsible for the show windows and the general appearance of the place. It will be a load off the owner's shoulders to do this. The record of sales will show the salesman's worth and his salary should be advanced in proportion to his work.

The subject of advertising is so important that it will be discussed at length in another article. It will be well to note here, however, that the small dealer wastes a great deal of money on ineffective advertising, not recognizing the fact that advertising to be productive must be persistent. Novelties, theater curtains and programs, billboards—all these have their proper places, but they are not the proper medium for the small dealer. Another waste is the tendency to bid low on an important job, hoping to land it for its advertising value. It is the height of folly to cut the margin of profit for this reason, for such advertising value is invariably overestimated. When everything is taken into consideration, it is safe to say that our estimate of $30 monthly is a reasonable figure, although the dealer will doubtless protest that he spends no such amount on advertising.

These three results of the new policy combine to effect another change in the character of the business. In the old store there was a general air of despondency. The overworked bookkeeper was a pessimist in good cause, the errand boy was shiftless, the windows were neglected and the stock was unkempt. And in the midst struggled the owner, hemmed in by petty troubles and seeing no light ahead. But how things have changed. The new bookkeeper, having all her time to devote to the accounts, is keeping the owner posted in the details of his business and has lifted a load of uncertainty. The cheerful optimism of the salesman is reflected everywhere, the windows are clean and well trimmed, the stock is cared for and even the boy has changed his front. All are proud of the new store on one of the main streets; its neighbors are well kept shops and the pace must be maintained. The advertising is bringing in new customers—business is good. Thus relieved of the monotonous drudgery that formerly took all his time, the owner can stop long enough to size up his field; he can handle his business intelligently and grow healthily.

The small electrical dealer is unfortunate in one respect. As noted before, he has a three-fold business, wiring contracting, fixture manufacturing, and retail selling. Each branch deserves the unhampered attention of an expert, and in trying to look after all three the average dealer makes a mistake. If he cannot build up a branch to the point where he can hire a competent foreman, let him drop that branch and push the other two. But in the average small city there should be no trouble in running all three. If the dealer can be brought to realize that hired hands can do nine-tenths of his routine work and probably do it better than he is doing it, then he is free to grow and not until then. Failure to realize this is most unfortunate.

The stock for a small store deserves a little study. If convenient to the jobber, a very complete stock can be maintained on a small investment. Our dealer will do well to confine himself to lines that he can always keep up. Nothing hurts trade any more than to turn away customers who seek some commonplace article. To say, "We do not carry that line" when some one inquires for a vibrator, is less harmful than, "We are out just at present" to a request for a dry battery.

Our dealer must anticipate the various selling seasons by about two months; for example, he should order his Christmas specialties during October and begin pushing their sale the last week in November. It is a good plan to keep a tickler file in which trade opportunities are noted. One is quite apt to get an idea for some midwinter campaign in July and then forget it before it can be used. When visiting in the large cities many things will be noticed that can be used at home a year later. Traveling salesmen generally have a fund of good ideas that can be drawn upon to enrich this file. Other sources of information will suggest themselves and it will soon become a valuable reference.

It is essential that the store should be attractive. Large showcases, well arranged show windows well built shelving and counters, comfortable chairs or stools for the customers, and above all good light and air are all drawing cards. It is a good idea to have a cleaning day each week and make house-cleaning the urgent business of the day. People nowadays expect these things as much as they expect courteous treatment. It's right that they should.

Many of the articles that make up the stock of the electric store, are small and their packages are irregular in size and shape, so that their appearance on the shelves is far from attractive. To overcome this, neat boxes, uniform as to size, shape and color, should be provided. If possible they should be obtained before the shelving is built and the shelves then so arranged that the boxes need not be piled one on the other. When these boxes are labeled neatly and all the small items of the stock are transferred to them the result is a very satisfactory system that is a strange contrast to the hit-or-miss method employed in many stores. One dealer who wished to adopt this method hesitated at the cost of having suitable boxes made. One of his employees rustled up a lot of shoe boxes from the shoe stores, treated them to a coat of calcimine and labeled them with gummed stickers. The result was very satisfactory. The cost was no item at all considerable.

It is a strange paradox that the artificial lighting of an electric store is generally very poor. In one place there is a bright glare from bare lamps, in another the light is struggling to get through an assortment of colored shades while not far away some forgotten corner is practically dark. The owner would buttonhole any fellow merchant who maintained such a lighting system and tell him he was out of date! The electric dealer's lighting is part of his display, one of his talking points, and it should be a little better than anything else in town. Let him tear out the old makeshift and install a system that is a credit to the business!

A review of this article will show that there is very little original material in it; in fact some of the ideas are pretty well worn. There has been no attempt to be original but rather to call the attention of the small dealer to some simple phases of his business that he may have overlooked. To anyone who tries to climb out of the rut, many petty problems arise. It is to be hoped that these simple suggestions may help to solve some of them.

How a Contractor Advertises.

Alex. M. Knauber Company, an electrical contracting firm doing business in Oak Park, Ill., and at 1642 West Madison Street, Chicago, has recently adopted the scheme of placing advertising clocks in many of the waiting rooms of the Chicago elevated railway stations. Printed in conspicuous type around the face of each clock, which clock is electrically operated and requires no winding, is the name of the firm and a statement of its line of business and its location. While the investment is considerable, Mr. Knauber, manager of the firm, says he feels that the investment will prove a good one.

THE KNIGHT PUBLIC FIRE-ALARM SYSTEM.—III.[1]

By E. E. Moore.

Closed-Circuit System.

This system is the same in principle as the Knight open-circuit, but the method of connecting up the street fire-alarm points one to another is different, though the alarm-boxes themselves may be the same in both systems. This system also automatically draws attention at the station if a line should break at any time. This is the only difference in working results that there is with the two systems.

Fig. 12 shows a circuit of alarm-points. These, it will be seen, are connected up in series on a loop metallic circuit. A current is constantly flowing round this loop, and any break in the circuit will affect certain instruments at the station in a manner to give an audible signal.

Figs. 13 and 14 give the layout for a number of points in a large town with three substations. In Fig. 13 all the alarms ring into the central station, and the apparatus there will automatically repeat the district calls into the substation affected by them. Circuits I and V are repeated to substation S^1; circuit II to substation S^2, and circuits III and IV to substation S^3. On the other hand, in Fig. 14, the fire-alarms from the various points are localized, the alarm-points in one area ringing into one substation, and the alarms from another area into another substation. Here again all or part of the alarms running into one station may be automatically repeated to any other station if necessary. The latter method of alarms coming direct to substations is unquestionably the best. It is likewise important that a repeating system should be able to distinguish and sort out certain signals for certain stations, so that directly a signal starts to come into a station that station knows that it has to turn out at once.

The station apparatus connections are shown in Fig. 15. The drop annunciators, when energized sufficiently, fall and operate their respective circuit-changers. The fault indicators are held at one indication so long only as they are energized, and show a different indication if current is cut off from them. The fault switches are used when a fault proclaims itself on the line as hereafter described. The switching over of any fault switch, besides altering certain electrical connections, mechanically replaces all the fault indicators, or rather such of these as may be in the short-circuited position, and if current is flowing through this part of the circuit they will be held there electromagnetically.

Consider now the system as a whole, working under different conditions with which it may meet.

(*a*) *Normal.*—The closed circuit, starting from the battery, goes through one coil of the alarm-relay, and branches out to all the disconnection-test indicators. Each disconnection-fault indicator then connects on to its respective A annunciator drop-flap, from there to its own circuit-changer and out to A line. Referring to Fig. 12, it will be seen that the circuit is closed through every alarm-point. The circuit enters the station again through leg B, across B circuit-changer through annunciator B and to the earth-fault indicator. This latter, however, is short-circuted by its manually operated switch.

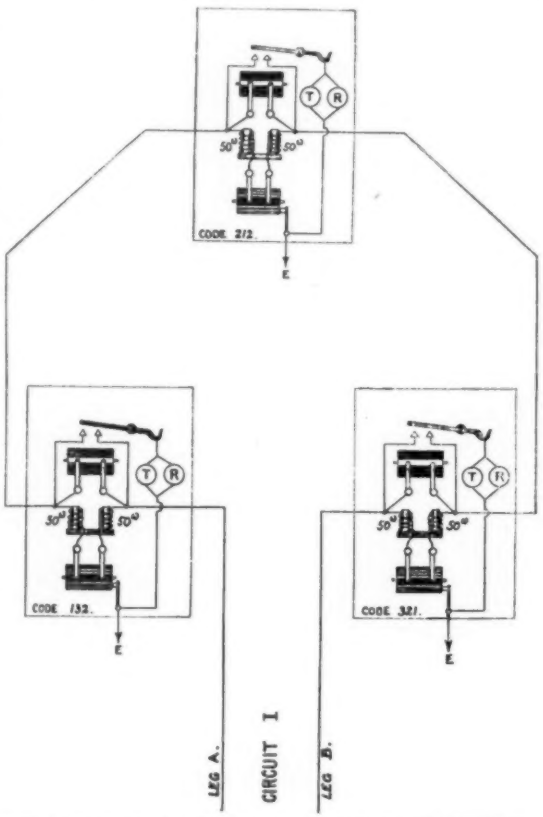


Fig. 12.—Circuit of Stations from which Alarms are Sent.

The whole of the B legs on all the circuits converge after passing their respective earth switches, and are joined across the B contacts of the control relay to the other coil of the alarm relay, thence to the other side of the battery, thus completing the circuit.

The fault indicators are wound to 2,000 ohms each, and as the A earth-fault indicator is always normally in circuit, only a small current is then passing round each of the loops. This is not nearly sufficient to drop any of the annunciator-flaps or to actuate the alarm-relay. The whole system thus normally consists of closed metallic circuits.

(*b*) *When a Point is Operated.*—The circuit the point is on is momentarily broken at the extension-drum contacts, the disconnection-fault indicator is de-energized and short-circuits its own electromagnet winding, so that this high resistance is cut out of circuit. Immediately afterwards (the clockwork at the alarm-point operated continuing to revolve) the circuit is intermittently put to earth at the code-drum contacts. The full current will then flow down each leg of the circuit, dropping both its annunciator-flaps, through the alarm relay to the main battery. This battery is split in the middle, where both circuits converge and go to earth through the code-receiver and earth-indicator.

With the first full current, both annunciator flaps drop and alter certain connections on their respective circuit-changers. No more current can now come in from B leg, as this line is switched on to A circuit-changer, which latter has now terminated B's line connection there. The remainder of the intermittent code-signal and code can therefore only come into the station on leg A of the circuit, whence it now goes direct to the alarm-relay, A battery, through the recorder and earth-indicator as before, and then to earth.

The intermittent and code signal of the point operated are thus rung out on the alarm-bell by the closing of the alarm-relay contact, in synchronism with the earthing of the line by the code-drum in the street.

As may be seen from the diagrams of connections, the whole main battery is used for operating the alarm-bell when this relay-contact is closed, but only A half of the battery is used for operating the recorder. This latter instrument places on record every signal received, and the starting of its clockwork is utilized to break the fault-indicating circuit directly a signalling current is received; otherwise the alarm-bell would be ringing continuously as for a fault. Indeed, this is what actually happens when the complete alarm-signal has been received and recorded. When the recorder stops, the bell rings continuously until the fault in-

1 From the *Journal of the Institution of Electrical Engineers.*

dicator has been replaced. As the electromagnet of this is short-circuited until the annunciator-flaps are also replaced, the first mentioned operation is not possible until the second has been performed.

(*c*) *Two or More Points on One Circuit Operated at or About the Same Time.*

As previously explained, when an alarm-point is operated, its signal can only come in on A leg of the circuit, or rather this is so when the circuit is in proper or normal working order. All alarm-points farther away down the line from the station are cut off from the station by the extension-circuit breaking drum of the alarm-point operated. If therefore another alarm-point farther away is operated while the first is sending in its signal, no current can reach it; and until it is again connected to the station battery by the nearer alarm-point finishing, it is held up by its electromagnet as explained in the open-circuit system.

This previous description will also explain what occurs when an alarm-point is operated nearer to the station on the line than the one first started.

It will be noticed from Fig. 12 that the alarm-point held up is connnected to the station every time that the code contact-drum of the nearer alarm-point connects its two contact-fingers together. Each time this occurs, however, the contact-fingers are simultaneously earthed, so that all the current from the station battery flows to earth at the nearer alarm-point, the held-up point being short-circuited and receiving no current. Thus any number of points operated on a circuit will automatically ring out and record themselves at the station one after the other.

(*d*) *Two or More Points on Different Circuits Operated at or About the Same Time.*—Practically the same explanation applies as that given for the open-circuit system.

(*e*) *Repeating.*—Provision is made for repeating any or all of the signals received at a station to one or more other stations. This is accomplished by means of the circuit-changers and repeating contacts on the alarm-relay. The former select the circuits which are to send their signals on to the other station or stations, and the latter makes and breaks this repeating circuit in synchronism with the original alarm-signal. By judicious arrangement of the various alarm-points in a large town, all points which have to call out another station besides the one they first ring into, may be connected to one circuit. Thus there is no necessity with this system for any stations to receive an alarm-call or an automatically repeated call unless that station has to turn out to it. By this method, on the first strokes of the warning intermittent signal being received, the men can be assembled, and by the time the code signal has rung they are nearly ready to be off to the fire.

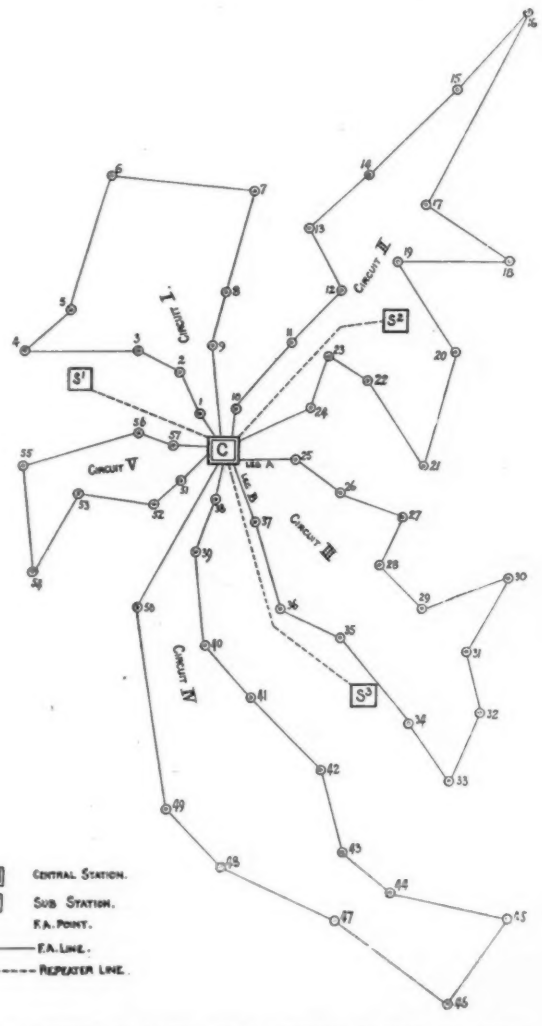


Fig. 13.—System in Large Town Arranged So that all Alarms Ring into Central Station.

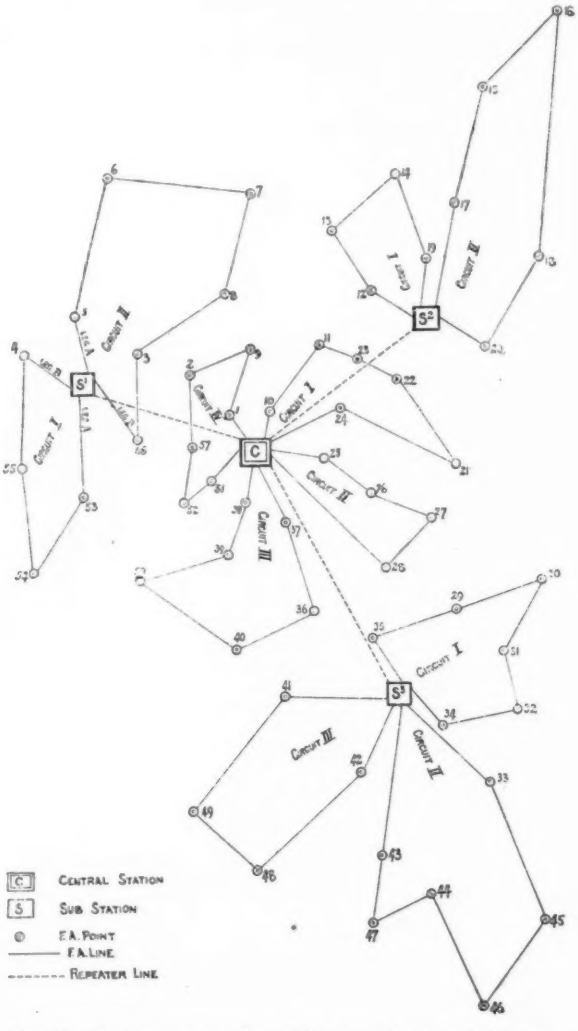


Fig. 14.—System Arranged to Ring into Local Substations.

Faults.

(*f*) *An Earth Developing or Extraneous Current on Line.*—The same explana-

tion given for the Knight open-circuit system applies so far as the results of an earth are concerned. The temporary remedy, however, is different with this closed-circuit system. The earth-switch is put to the fault position. This does three things: (1) it mechanically puts the B fault-indicator to show "earth;" (2) the short-circuit is taken off this indicator, the high resistance of its electromagnet is put into circuit, and as it forms part of the closed metallic circuit, the indicator will be held in this position irrespective of any current it may be receiving due to the faulty earth; (3) the fault-alarm circuit is switched on. The circuit now has a resistance of at least 2,000 ohms between either side of the battery and the earth fault, and even a dead ground will not pass sufficient current to operate the annunciator flaps or alarm. Directly an alarm is operated, however, the line is momentarily broken and either A or B fault indicator is de-energized for a short period, thus allowing it to short-circuit itself and cut out its resistance. Which of the two fault indicators is thus de-energized depends upon the alarm-point operated, and the locality of the earth. Obviously that indicator will remain unaffected which has nothing to break its circuit between itself and the earth-fault. Under these conditions the signal will therefore come in on that leg of the circuit which has the operated alarm between the station and the earth-fault. The alarm-point having been operated, the earth-fault is cut off from this leg by the extension-line contact-drum; and the high resistance at the station on this leg having been cut out, the subsequent intermittent earthing of the contact-fingers on the code-drum will send the signal through to the station.

(*g*) *A Line Broken and Not Earthing.*—In this case A fault indicator drops away, giving a visual indication "broken circuit," and ringing a bell. It also cuts out the high resistance of its electromagnet. The A fault switch is put over, thus stopping the bell. Any alarm-point now being operated will come in on that leg of the circuit which has not the break between the point operated and the station.

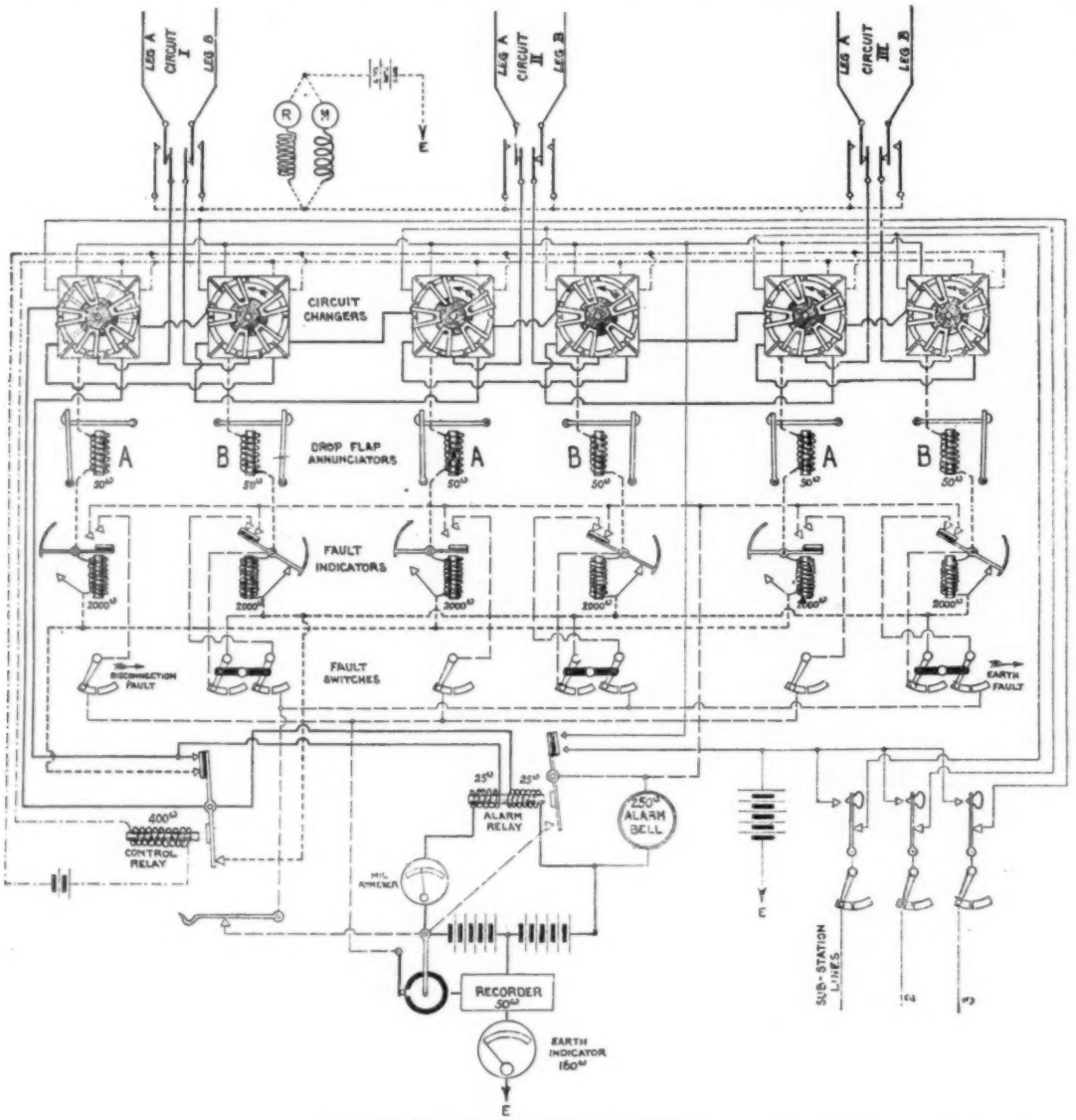


Fig. 15.—Connections of Station Apparatus.

(*h*) *A Line Broken and Earthed.*—If a line breaks and both of the broken ends become earthed, the result is of course the same as when a line is earthed without breaking. If, however, when the line breaks, only one of the broken ends becomes earthed, two cases arise: (1) leg A earthed; and (2) leg B earthed.

(1) A certain period of time, even if extremely short, must elapse after the break and before the broken end be-

comes earthed. Directly there is a break, the fault-indicator on leg A will fall away, indicating "line broken," closing the alarm-circuit and giving a continuous ring. The subsequent earthing of this leg will have no further effect.

(2) The A side will act as described in (1), but B side will also close the bell-circuit through the alarm relay-contact.

The temporary remedy for (1) is to change A switch over. This disconencts the alarm-bell from that fault-circuit, and any alarm that side of the break will come in on A side, whilst any alarm on the unearthed side B will come in on the B side.

When (2) occurs, the changing over of A switch will not stop the bell ringing. The other fault-switch, therefore, being put over, the effect is as described in (*f*). The system is now again in working order, and will receive any calls, and the faults can be remedied as soon as convenient.

(*i*) *Two Legs of a Circuit in Contact.* —The method of joining up the boxes in all closed-circuit systems, viz., by loop-lines, generally obviates the necessity of running the out or A line on the same route as the in or B line, so that unless the two lines do run close to each other there is no chance of them making contact.

With the system now being described, however, even if the two lines on a circuit become short-circuited, any point operated on that circuit under these conditions will ring into the station—provided, of course, that the lines are otherwise in order. But as any other fault will proclaim itself, it is practically impossible for any of the alarm-points or lines to be in such a condition that they are not capable of sending an alarm in when a point is operated, without the station knowing of the fact and taking steps accordingly.

(*j*) *Telephonic Communication.* — This is provided in a very simple manner, similar to that in the open-circuit system. The receiver being taken off the hook, or the hand set plugged into the fire-alarm jack, the loop is earthed and the bell rings at the station. A speaking-key is provided for each circuit at the station. The automatic telephone switch at the station breaks the fault alarm-circuit.

Among the Contractors.

Vivian & Wiesinger, electrical contractors of Monroe, Mich., have the contract for all electrical equipment, including fixtures on the new Reapers Theater Building, in Monroe, and also the contract for wiring and fixtures for the Trinity Lutheran Church. Both jobs are conduit construction throughout.

M. F. Crankshaw and W. R. Wait have recently established an electrical contracting business at 509 Buckham Street, Flint, Mich. The firm name is Crankshaw & Wait. Both the gentlemen mentioned have lived in Flint for many years and their extensive acquaintance here, coupled with their long practical experience in the electrical business, should insure for them a large measure of success.

William Farr.

The Piedmont Electric Company, of Asheville, N. C., is one of the best known electrical contracting and electrical supply houses in the section of the South where its headquarters are. Its president and manager is William Farr, the man whose photograph appears below. Mr. Farr went down to Asheville from Brooklyn, N. Y., the city of his birth, some 18 years ago. Prior to that time he had worked in Philadelphia for the firm now so well known as Queen & Company, and for H. E. and C. E. Baxter, a concern then manufacturing

William Farr, President and Manager of Piedmont Electric Company.

electrical goods in Brooklyn, and as an electrical mechanic in the Brooklyn navy yard. While working at his trade in Brooklyn he utilized his spare time attending school at Pratt Institute, and thus acquired a substantial grounding in the theoretical side of the science of electricity.

Having taken up the electrical contracting business soon after his arrival at Asheville and having been engaged in it continuously ever since, Mr. Farr is one of the oldest contractors in the South. At first he was in the business alone; then he was a member of the firm of McKay & Farr; eleven years ago the Piedmont Electric Company was organized and he became its president and manager. This firm has put in some of the most important electrical installations in the Carolinas and the neighboring states. The company carries a regular jobbing house line of electrical supplies, and with this branch of its activities it covers a territory having Asheville for its center and a radius of about 250 miles around.

Mr. Farr is a splendid type of the modern successful business man, as well as being an electrician of such thorough training. Besides the position mentioned above, he is president of the Black Mountain Telephone Corporation and of the Tri-County Public Service Company. Those who have had dealings with him give him a reputation for promptness and reliability that is most enviable; the business he has built up is itself convincing evidence that his friends' estimate of him is a correct one. He is known, moreover, as a salesman of unusual ability. Other salesmen who travel his territory say that he can secure an order for electrical material and equipment where everybody else has tried hard and failed.

Mr. Farr is a member of the Knights of Pythias, of the D. O. K. K. and of the Travelers' Protective Association. He impresses one as a man who makes friends readily, and keeps them. He is 38 years old.

Special Rules in Force in Detroit.

In the city of Detroit, Mich., where Ben W. Clark is the chief electrical inspector for the city, the rules of the Public Lighting Commission specify that there shall be but one service for each building and that this must enter the rear of the buidling, on the side facing the alley. Terrace buildings must have but one service contract, and sections must be connected with conduit on the outside of the building. Combination buildings for stores and flats or business and factory must be connected as is required in the case of the terrace building, unless the construction of the building necessitates more than one service contact.

The main cutout, switch and meter loop must be located within seven feet of the floor. They must be placed in the cellar or basement if this runs to the rear of the building and is readily accessible. The installation may be in a weatherproof cabinet on a rear porch if there is no basement or other suitable place inside the building. Meters must not be installed nearer than within 10 feet of motors or generators, the rules say.

Contractors Licensed in Asheville.

In Asheville, N. C., which is a city of some 25,000 people, electrical contractors are required to pay a license fee of $25 per year. The charges for municipal inspection of wiring is intended to be only sufficient to cover the actual cost of inspection. C. M. Warren, a popular young electrical worker, has lately been appointed city electrician and will have charge of all inspection of wiring.

Dollar Wiring Kinks.

Every reader is invited to contribute to this column. It does not matter how few words are used to explain a "Dollar Wiring Kink," provided the idea is made clear; and if a diagram is necessary, a rough pencil drawing will serve. The idea itself must, of course, be new and bright. A dollar will be sent to the contributor upon publication.

Tool for Cutting Outlets in Plastered Ceilings.

A tool that is very useful for cutting outlets in plastered ceilings in finished houses may be made from an ordinary ceiling-outlet plate. The edge of the plate should have saw teeth cut in it all the way around. Then two slots are cut in the bottom of the plate on diametrically opposite sides of the center, which slots can usually be made by cutting away the metal between holes already in the bottom and are for the

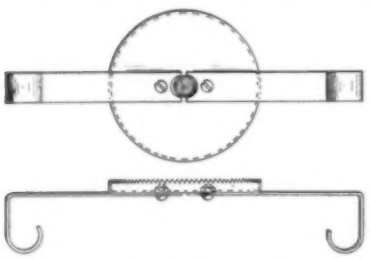


Fig. 1.—Plan and Sectional Views of Complete Tool.

small bolts with which the handle of the tool is to be attached. The handle is made by taking a piece of iron about an inch wide and a sixteenth of an inch thick, drilling a half-inch hole in the center of it and two quarter-inch holes to match those for the fixture-stud bolts at either side of the center, bending the outer ends down to form handles, and finally sawing the piece in two across the central half-inch hole.

When these handles have been bolted on the bottom of the outlet plate they can readily be adjusted so that the opening between them will fit either a three-eighths-inch or a half-inch gas pipe at a combination ceiling outlet. Where a straight electric outlet is to be cut, a guide for tool can be made by plugging up a piece of half-inch metal sleeving with a plug from which the pointed end of a wood screw projects, and screwing this guide to the lath at the center of the outlet.

The use of the tool described in the foregoing prevents plaster chips from falling on the floor of the room, and eliminates the necessity of the usual procedure of marking around the outlet with a ceiling plate and then taking a screwdriver and chipping out the plaster, the pounding of which process is quite likely to loosen or break the plaster around the outlet. J. B. Wathier.

Cutting Flexible Tubing.

I find a great deal of trouble in cutting certain kinds of flexible tubing with my knife the knife becoming sticky and hard to cut with. This can be overcome by wetting the knife in water. This helps a great deal and saves much trouble in skinning wires after the cutting.

Milton H. McGuire.

Connections for Annunciators.

Where two annunciators are to be operated from the same set of push-buttons, I find the connections illustrated in Fig. 2 to be the most satisfactory one. The diagram needs no explanation. It

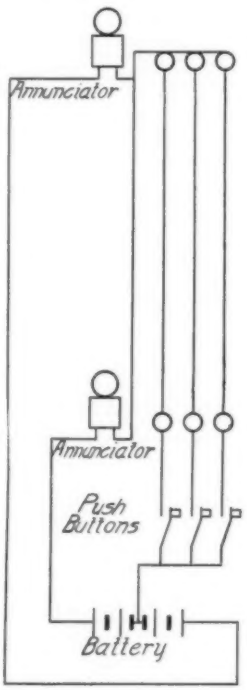


Fig. 2.—Connections to Annunciators.

will be noted that with this connection the current is divided properly between the two annunciators, and that confusion is thus avoided.

Jake Hendricks.

Installing Service Pipes.

In the issue of July 12, a Wiring Kink by J. B. Wathier describes the author's method of installing service pipes on the outside walls of buildings served from an overhead line.

I have read this Kink several times, and I am unable to see how he makes his method of bending pipes work out. He must not intend to use rigid conduit, for he cannot bend pipes larger than three-fourths of an inch in diameter in the way he describes. Moreover, to set a cabinet on a wall, as he describes, and put a piece of pipe into it through a hole in the wall and try to bend the pipe would usually mean that the cabinet would be pulled off the wall. Again, it would be impossible to make the bends short enough where the pipe came through the wall. I have made installations of the kind he mentions, but I used a Type L condulet instead of a bend to carry the pipe into the basement. In this way I could get my conduit to fit close to the wall, and could make a good job. Jack Robinson.

An Electric Alarm Clock.

I was called upon not long ago to arrange on alarm clock so that it would operate electric bells in rooms other than those in which the clock itself was located. Fig. 3 illustrates the method of accomplishing the object desired. A small piece of copper was attached to the clock in such a position that the key for winding the alarm would make contact with

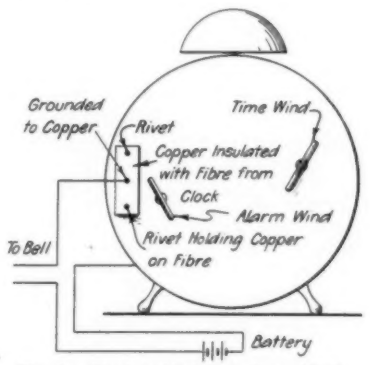


Fig. 3.—Clock with Connections Made.

it as the key turned, the piece of copper being insulated from the metal casing of the clock with a piece of fiber. One side of the bell circuit was opened and the clock inserted by attaching one wire to the metal casing and the other to the piece of copper. Whenever the alarm begins to ring, the backward turning of the alarm-wind key closes the bell circuit. Karl S. Wonderly.

Installing Conduit on Terra Cotta Walls or Ceilings.

In working in buildings where the walls or ceilings are terra cotta it is somewhat of a job to drill holes small enough to hold toggle bolts or expansion shields, as the terra cotta is apt to break off and leave the hole too large. To overcome this I took a small twist drill and pointed it up a little and used it with my bit brace, and I found that it did the work very well.

E. W. Dullea.

Public Service Commissions

CALIFORNIA.

The Railroad Commission of California has authorized the Pacific Gas & Electric Company to issue $5,000,000, face value of principal, of its general and refunding mortgage gold bonds, maturing January 1, 1942, and to bear interest at five per cent per annum. Of the issue $1,590,000 is for additions, betterments and extensions heretofore made, and $3,410,000 for additions, betterments and extensions to be hereafter made. The company expects to make a total expenditure for new construction work for the year 1913 of $13,721,680 in connection with its various departments. The largest items in the program of construction for the year 1913 include South Yuba hydroelectric development, including the Lake Spaulding and Bear River work, $3,854,354.08; installation of three power houses in Placer district, $2,267,818.30; steel tower transmission lines from Drum power house to Cordelia substation, $1,129,633.99.

MASSACHUSETTS.

The Massachusetts Gas and Electric Light Commissioners have ordered the reduction in the maximum net price of electricity sold by the Edison Electric Illuminating Company of Brockton from 15 cents to 12 cents per kilowatt-hour. The decision follows a complaint of more than 20 consumers, on which public hearings were held by the Board in Brockton. The new rate is effective August 1. Hitherto the maximum rate was 16.66 cents per kilowatt-hour, with a 10 per cent discount for prompt payment, making a net price of 15 cents, which applied to residence and office lighting and was for the first 30 hours' monthly use of the connected load. In excess of such use the gross price was 10 cents, or with the discount, 9 cents net. For store lighting the same rate applied, except on a three-year contract, when 10 per cent additional discount was allowed. For factories the rate is the same as for residences, except where Edison power is used wholly, if such customers purchase their own lamps, they pay for lighting, with 30 to 40 horsepower motors installed, 12 cents a kilowatt-hour; 40 to 50 horsepower installed, 11 cents, and over 50 horsepower, 10 cents a kilowatt-hour, these rates being subject to 10 per cent discount within 10 days. There is a minimum charge of $1.00 a month per motor.

There are various other rates in which the base rates run from 5 to 20 cents a kilowatt-hour and the discounts for prompt payment from 10 to 50 and 10 per cent and dependent upon a variety of other conditions, such as the using of current exclusively for light and power with a minimum of $300 a month and for the non-use of current during the peak hours in the winter. There are also flat rates of a fixed amount per month for fixed numbers and kinds of lights for restricted and unrestricted use. Power rates for motors up to 10 horsepower start with a base gross rate of 15 cents and range from that to 5 cents, according to the size of motor and length of daily use. For larger motors there is a monthly charge based on the maximum demand, and a gross price of three cents a kilowatt-hour for all electricity consumed, with discounts running as high as 44 per cent, according to the size of motor.

The maximum net price of 15 cents was in force since July 1, 1909, and before that it was 18 cents. In April, 1910, the secondary net rate of 9 cents was given a wide application by the reduction of the hours at the primary rate from 50 to 30 hours' use of the connected load per month.

Most of the complainants were small lighting customers, and their grievances seem to have arisen mainly through misunderstanding and distrust of the company's determination of their connected load. The company's practice was to determine the connected load by ascertaining the aggregate wattage of lamps installed. The main difficulty lay in the system of charging and the method of its application which caused some customers to believe that others using electricity under like conditions were obtaining an advantage over themselves. This resulted from the fact that a customer's rate depended not upon the amount used but upon the relation of that amount to the connected load. As the ratio of his consumption to his connected load increased, the average price per kilowatt-hour decreased; consequently, two customers having lamps of equivalent wattage installed, but used for a different number of hours in the same month, were charged different prices. The same result followed where two customers used equal amounts of electricity but had installations of unequal wattage.

The Board in its decision sets forth that in previous cases it has admitted the truth of the claim that, other conditions being equal, length of use of a given demand has an influence upon the company's costs. It has recognized the importance and desirability of increasing output without proportionately increasing investment in order to decrease the average cost of electricity sold. But the Board is convinced that "a mere difference in the quantity used does not of itself constitute such a difference in price, that differences in lamp installation are very unreliable indications of actual differences in demand, and that whatever may be said as to the importance of the length of use of a given demand, unless variations in use are sufficiently marked, their influence upon cost is slight, and as a foundation for differences in price, probably negligible. Indeed, differences in price, where made, seem to be based upon considerations of commercial expediency rather than a purpose to establish prices which shall charge each customer as much and no more than he should pay."

It appears that about 90 per cent of the company's customers are interested in the maximum net price. More than half of these do not use electricity which, in view of their connected load, entitles them to the secondary rate. Even the business and residence customers who become entitled to the secondary rate appear to pay average prices exceeding 11 and 12 cents, respectively. But certain customers who enjoy special rates and long-time contracts are charged prices which average lower. Many of the latter are not strictly dependent upon the Edison company for their electricity, while the former are. The Board holds that the company should serve their needs without discrimination and charge them no more than a reasonable rate.

MINNESOTA.

After investigating the Wisconsin method of regulating public utilities, the special legislative public utilities committee of Minnesota appointed to study the subject and draw up a bill has adjourned to August 18, when further hearings will be held.

No conclusion has been reached, but

there is considerable opposition to giving the railroad commission any far-reaching powers to regulate public utilities. Several members of the committee believe that local control of utilities should not be surrendered to such an extent.

Several schemes for adjusting the basis of valuation of public utilities have been brought up by the members of the committee. One is to fix valuation for rate-making purposes at the actual physical value of the property, plus 15 per cent as a reasonable addition for its value as a going concern. Another system, suggested by John R. Commons, the expert economist of the University of Wisconsin, is to make valuations and prescribe accounting systems, the cities to continue to regulate the public utilities with the aid of the expert service thus placed at their disposal.

The committee has invited the mayors of all Minnesota cities to appear before the committee or send representatives to the hearings this month to give information about public utilities. The committee is paying much attention to judging the sentiment of the people in regard to such a commission. The committee is composed of Senator J. H. Hackney, chairman, and Senators W. S. Dwinnell, Julius A. Cokker, Ole O. Sageng, Frank E. Putman, George H. Sullivan and H. W. Cheadle.

NEW YORK.

The Public Service Commission for the First District has adopted an order directing all street-railroad corporations in the city of New York to prohibit smoking or the carrying of lighted cigars, cigarettes and pipes on the cars or the platforms of cars operated by them, except the open cars having running boards along the sides and having seats accessible directly from such running boards. On such cars smoking will be permitted on the four rear seats of each car, including the seats on the back platform. The order also prohibits smoking or carrying lighted cigars, etc., in the stations, station platforms, station stairways, waiting rooms, waiting cars or shelters. The companies are required to enforce these regulations and to post conspicuously in cars and stations proper notices stating that such practices are prohibited. The order was made out to take effect at once.

The New York Edison Company and the Astoria Light, Heat & Power Company have made application to the Public Service Commission for the First District for permission to issue additional securities. The New York Edison Company asks for permission to issue $15,800,000 in capital stock in addition to $50,153,400 already issued. The proceeds of the new stock are to be used to pay off notes given to the Consolidated Gas Company for money used on the plant and property of the Edison Company. The Astoria Light, Heat & Power Company asks for permission to issue $5,000,000 in first mortgage 5.5 per cent bonds and also $9,500,000 capital stock in addition to $500,000 capital stock already outstanding. The proceeds of the proposed stock and bonds are to be applied to the refunding of $14,125,000 in notes of the company held by the Consolidated Gas Company and for the retirement of $375,000 outstanding as mortgage bonds. The Commission will hold hearings on both applications on August 12.

The Public Service Commission, Second District, has authorized the Federal Telephone & Telegraph Company to issue upon the security of its first mortgage dated March 24, 1909, its five per cent bonds maturing in 1959 to the par value of $500,000. This authorization is given provided that not more than $200,000 of such bonds shall be sold at one time, and no further sale shall be had until the proceeds from the first sale shall have been used for certain purposes so that not more than $50,000 shall remain unexpended; that such bonds shall not be sold for less than 83 1-3 per cent of their par value and accrued interest, to give net proceeds of $416,566.66; that no bond thus authorized which shall remain unissued one year from the date of the order shall be sold without further permission from the Commission; that such bonds or the proceeds thereof shall be used solely to purchase and retire any of the following outstanding underlying bonds of the companies, which have been merged with the Federal Telephone & Telegraph Company: Corning Telephone Company, $84,000; Frontier Telephone Company, $2,500,000; Hanover Telephone Company, $100,000; Inter-Ocean Telephone & Telegraph Company, $2,000,000; Ithaca Telephone Company, $95,000; Livingston County Telephone Company, $110,000; Penn Yan Telephone Company, $50,000; Salamanca Telephone & Telegraph Company, $39,000; Valley Telephone Company, $110,000; Watkins Telephone Company, $25,000; Wellsville Telephone Company, $40,000; Wyoming County Telephone Company, $25,000.

The Commission's order also provides that these underlying bonds shall be purchased at the lowest market price for which they can be obtained, and that for those of the said underlying bonds which bear six per cent interest the purchase price shall in no case exceed 100 per cent of their par value. It is also provided that if any of the bonds authorized shall be exchanged for any of the underlying bonds outstanding, the cash equivalent received for the new bonds and paid for the old bonds is to be on the basis of the average price received for the new bonds in the open market during the period of six months prior to the date of the exchange. If none of the new bonds shall have been sold before such exchange takes place, the cash equivalent shall be 83 1-3 per cent of the par value of the new bonds.

A complaint by Patrick McGovern & Company against the New York Edison Company was adjusted at an informal hearing on July 30, before Commissioner Milo R. Maltbie of the Public Service Commission for the First District. The complainants have the contract for the construction of Section 9 of the Lexington Avenue Subway, and they maintain a yard at the foot of East Seventy-sixth Street, where cement is mixed. They claimed that they should have been given a lower rate for current supplied to this yard, under the schedule for the "aqueduct rate," that prevails for current supplied for the work in subway excavations. The company contended that as the yard is a separate establishment, the aqueduct rate should not apply.

John W. Lieb, Jr., vice-president of the Edison Company, admitted that the Bradley Contracting Company, which has four sections of the same subway, has the benefit of the lower rate for its yard on the river front, and said that this course was justified by the fact that there is a physical connection between the Bradley yard and the excavation, inasmuch as air is compressed at the yard and sent through a pipe to the subway.

After hearing all the testimony, Commissioner Maltbie said that he was inclined to regard the precise point at issue as an open question, but he was of the opinion that the usage regarding all such yards should be uniform. It was evident, too, that he did not regard the presence of the pipe-line as making any essential difference, since the McGovern yard is maintained solely for purposes of subway construction. In any event, he said, the Bradleys would certainly be entitled to a hearing before having their rate raised.

Mr. Lieb acquiesced in the last statement, saying it might make a difference to them of some $5,000 a month. He added that it was very unlikely that the Edison Company would raise any rate, and in view of the attitude of the commissioner, he practically announced that the lower rate would be conceded to the McGovern yard. He inquired particularly as to whether the Commission would insist on having the bill refigured for more than a year past—a matter of considerable importance, as other contractors may want their bills refigured also.

Mr. Maltbie said he would not undertake to cross that bridge until he reached it, and as he was about to leave on his vacation, he suggested that the Edison people confer with Mr. McGovern and his engineer, Julian N. Walton, of Walton & Beer, and see if they could not adjust the matter themselves.

Among the Supply Men

CODE EQUALITY AND SALES POSSIBILITIES.

By William G. Campbell.

Peculiar to that part of the electrical industry having to do with staple wiring materials is the cold fact that approved goods will do. Since the days of charlatanry in selling have gone by, only authentic points of superiority are available to the salesman. Thus, manufacturers of competitive lines of approved commodities introduce elements of individuality into their products. The distinctive features may be a patented weather proofing, or merely a detail as comparatively unimportant as the package.

While the salesman, by reason of wide experience and exact knowledge of the customer's needs, can frequently offer invaluable suggestions to the house, the problem of getting a better than "code standard" product is essentially a factory one. The work of the salesman—and incidentally the advertising man—commences with recognition of the selling points; this phase being equally important with proper presentation. How often have we overheard the purchasing agent asked, "How are you fixed for pipe today?" much after the manner of an order taker saying to an east side delicatessen dealer, "Let me send you a barrel of pickles." Invariably the P. A.'s answer to the query will be, "What is the price of pipe today?" Almost unconsciously his mind settles itself on price, largely for the reason no other thought was suggested. By first projecting the points of superiority, the question of price becomes secondary, if indeed it enters into the matter at all. The mind filled up with advantages exclusive to one product naturally will not dwell much on a matter common to all products.

Since the electrical industry is preeminently one tending toward the advancement of civilization, we of course find in it a superior grade of intelligence—ever on the lookout for improvement. Consequently the attitude toward a possibly better new specialty or an improved old product is receptive. This receptive attitude is by no means confined to any particular branch of the industry, nor even to the industry. Public preference for tungsten-lamp lighting over arc lighting and carbon-filament lamps is an example of this. As the public is more easily interested in what it sees, since this most directly affects it, just so will each branch of the trade be influenced by that which concerns it most.

The contractor will listen more attentively to arguments about material which cuts down the installation cost. As he can obtain the inspection certificate on a job when any kind of "approved" material is used, it is obvious that the betterness of a product must be presented to him from the labor-saving angle. Any "better than code" material, be it wire, pipe, fittings, or whatsoever, can be so presented. While reducing the "job cost" is ever a pleasant topic, the contractor is indeed interested in his work after the installation has been completed. First-class work brings repeat orders, and profitable extras. Strictly code material will do an ordinary job, but it takes "better-than-code" material to put the finishing and lasting touch to an extraordinary job. Contractors are alive to this, even though they see it secondly, and their orders to dealers bear this out.

The jobber's first answer to a salesman with a new article is, "Create a demand; we handle what is called for." In general this is true, but on account of credit arrangements it frequently happens that the jobber can sell his trade any line he has in stock. The jobber being only secondarily interested in "better-than-code" material, must first be made to appreciate that which is of primary interest. No—price is not the question—even though such a thought may have involuntarily crossed your mind. It is often such a small detail as the package that most interests the dealer. Convenience in handling, small storage space required, less number of styles by reason of interchangeability, advantages such as these will be of first interest because they enable a supply house to more expeditiously handle their business and to give their customers better service. The author knows from personal experience that on a common commodity—standard drawn-steel outlet boxes—one of the largest electrical supply houses in the East paid 10 per cent premium for goods packed "unit system" in cartons and cases. The old method of packing this class of goods was in barrels, both cumbersome and expensive for the dealer to handle, but easy enough for the manufacturer, who shipped in larger quantities. This particular jobbing house was of course very much interested in the secondary element, quality of material, it being progressive and recognizing fully the desirability of supplying its customers with what it believed to be the best. But the fact that the boxes in themselves were "better than code," did not make a sufficient reason for an added 10 per cent, the labor and space-saving package was necessary as a supplement. This illustration can be accepted as a criterion, since the house referred to is of national importance and has in its organization men recognized as being among the brightest in their field.

Buying the "case goods" at an added 10 per cent was the result of presentation. Merely asking "Want any outlet boxes today?" would have meant nothing, but "let me show you something better—something that will enable you to more economically and efficiently handle your outlet-box business"—spelled an added 10 per cent for the manufacturer and two tens in money saved for the jobber.

The illustration used is applicable in general to any kind of material. The various commodities adapt themselves to radically different lines of development and presentation, but all are subject to the rewards attendant upon improvement.

The Frank H. Stewart Electric Company, Philadelphia, Pa., is having a historical painting made of the first United States Mint Building, erected in 1792. This was the first building erected by authority of Congress, and was the sole United States Mint for a period of 40 years. It was razed in 1911 to make way for the new building of the Frank H. Stewart Electric Company. The painting will be the first reproduction ever made of this old building. The company's new catalog, No. 17, is now on press, and, like all its former catalogs, will be a standard reference of authority for the purchase or specification of dependable electrical devices.

Questions and Answers.

All readers of the Electrical Review and Western Electrician are invited to submit questions and answers to this department. Full names will not be printed except where the writer indicates his willingness therefor. Anonymous communications will not be considered. Questions relating to electrical matters of any kind will be inserted. Answers from our readers should be received in this office preferably within ten days of the date of publication of the question, and will be published in a subsequent issue. Payment will be made for all answers published.

Questions.

No. 142.—Allowance for Reduced Maximum Demand in Summer.—Recently I read an article explaining a rate system used by a British central station in which the number of hours charged for at the primary rate was less in summer than in winter, so as to compensate for the reduced maximum demand and decreased lighting load in summer and to encourage the use of electricity for cooking. Is this system in use anywhere in this country?—F. D., Racine, Wis.

No. 155.—Prevention of Corona Loss.—In steadily increasing the voltage of long-distance transmission lines, what precautions are taken to prevent or minimize the loss from corona?—E. T. H., Phenix, Ariz.

No. 157.—Forming Storage-Battery Plates.—In electrochemically forming storage-battery plates direct from the lead what acid is the best to use? Has the use of nitric acid for this purpose been so perfected as to make its employment safe? Is reversal of the plates after first forming them always necessary?—F. B. E., Chicago, Ill.

No. 158.—Negative Booster.—What is meant by a negative booster for an electric street railway? Does it lower the voltage when the load is light?—T. N. W., South Bend, Ind.

No. 159.—Electric Vehicle Formulas.—Have any formulas been developed for determining the size of motor (horsepower rating) required for an electric vehicle, also the size of lead storage battery (ampere-hour capacity), when the approximate dead weight and live load of the vehicle, the maximum running speed and street grade are known and the car is to be used in a city with well paved streets?—C. H., Albany, N. Y.

Answers.

No. 151.—Copper Wire Base.—Will some one kindly explain how the base on copper wire is calculated from standard spot or electrolytic copper quotations? If the wire base is not calculated from these quotations, kindly explain how it is calculated.—R. L. L., Minneapolis, Minn.

Replying to the above question, when copper-wire prices are published by trade papers, the quotation given usually covers No. 8 B. & S. gauge hard-drawn wire. The price is based on wire-bar prices insofar as it must necessarily equal the cost of the original electrolytic copper, plus the cost of manufacture, plus the manufacturer's profit, and these last two items are held fairly close in the various works by competitive conditions. The price on other sizes of wire than No. 8 will vary according to the size (it costs more to draw fine wire than coarse), while with any size there may be certain extras, such as annealing, tinning, etc. The dependence of wire prices on wire-bar prices can be seen when the copper market is fluctuating widely, although it always appears to me that the advances are followed a little more closely than are the recessions in wire-bar prices. It is interesting to note that the cost of manufacture of copper wire, a purely mechanical drawing process, which I have seen given as about $20 per ton, exceeds the cost of the highly complex electrochemical refining of the copper ($10 to $12 per ton).—D. M. L., Elizabeth, N. J.

No. 153.—Thermoelectric Couple Actuated by Sun's Rays.—Has any successful attempt ever been made to generate electricity direct from the sun's rays by focusing them upon a compound thermoelectric couple? What voltage can be generated in this manner?—J. T., Jacksonville, Fla.

No successful attempt has been made to use the sun's rays as a direct source of electrical energy, mainly because of the extremely low efficiency, not more than a fraction of one per cent of the heat available to warm one set of junctions being converted into electrical energy. Just what to expect from such a source can be seen rather roughly by comparison with the gas-heated thermoelectric battery of Clamond, in which the elements were made of strips of german silver soldered to blocks of an alloy of antimony and zinc. The electromotive force of a single element of this kind when the junction was at the room temperature and the other one heated nearly to the melting point of the antimony-zinc alloy was 0.04 volt. Using the sun instead of the gas flame we could get only an extremely low electromotive force. Such battery or generator would be extremely costly and bulky to generate even a very low voltage and give a reasonable output.—H. E. W., Chicago, Ill.

A few years ago the writer made a study of the possible heat value to be obtained from the sun's rays at various points on the surface of the globe and found that it was not practical to use this heat directly on account of the following facts: There is sufficiently intense heat at the equator only; this heat varies greatly at various periods of the 24 hours; it varies with the condition of the atmosphere and even at its greatest value is comparatively low in temperature. Without going into the exact facts, which would take some time to again work up, it is sufficient to say that at the tropics 160 square feet of surface would be required to collect sufficient heat to develop a horsepower; this would be developed during the summer months from 9 a. m. to 4 p. m. as maximum time and amount, the balance of the time shading to zero. A thermocouple outfit covering 160 square feet would be very expensive and the interest charges would more than offset the cost of fuel.—W. M. P., Seattle, Wash.

No. 156.—Theater Wiring.—In wiring for the lighting of the auditorium of a theater is it ever required to have all these lighting circuits controlled from both the electrician's switchboard on the stage and from the box office, or does the box office control only the special emergency lights?—H. W., Springfield, Illinois.

In wiring the auditorium of a theater it is never customary to control these lights from the box office or at any point except the stage switchboard. The reason for this is that it is necessary to operate the auditorium lights as well as the stage lights during a show. For instance during the performance of a comedy it is desirable to have more light in the auditorium than during a tragedy or a spectacular performance or a drama. It is also frequently necessary to make a quick change and the stage and auditorium lights are all out for a few seconds and quick work is called for in operating the switches. Vaudeville theaters require more light in the auditorium during some acts than during others and no matter what class of show is being played all light cues are handled and the lights controlled at the stage switchboard on the prompt side of the stage, generally in the first entry. The one exception to the above is the light required by city ordinance or by the National Board of Fire Underwriters in all exits. These lights are usually required to be controlled in the front of the theater at some point where the switches are easily accessible, yet so protected that same will not be tampered with by unauthorized persons, the box office being frequently selected, but not always, as a location for these switches. The stage electrician is not supposed under any circumstance to have control of these exit lights.—C. T. P., San Francisco, Cal.

In wiring for the lighting of the auditorium of a theater, it is optional with owners or architects, whether or not to control all the general auditorium lighting from both the stage and the box office. As a matter of fact, in large theaters it is rarely, if ever, done and it certainly is not required by inspection bureaus. To do so would be very expensive, would necessitate very compli-

cated wiring, and might result in some embarrassing situations if one or more switches in the box office were accidentally closed during an act when the house should be dark. On the other hand (to quote from National Electrical Code, Rule 38-t) "Exit lights and all lights in halls, corridors, or any other part of the building used by the audience, *except* the general auditorium lighting, *must* be fed independently of the stage lighting, and *must* be controlled *only* from the lobby or other convenient place in front of the house. All fuses must be enclosed in approved cabinets." The lighting thus required for box-office control includes all lights which are usually left burning during a performance. Local conditions and good judgment will indicate whether a few lights near the main exit, say under the balcony might not be wired on a special circuit from the emergency service and controlled by three-point switches, one in box office and the other on the stage board.—H. A. C., Pittsburgh, Pa.

Ozonators for Direct-Current Circuits—A Correction.

In the ELECTRICAL REVIEW AND WESTERN ELECTRICIAN of June 28, in connection with the reply to a question relating to ozonators for direct-current circuits, it was stated that the Supreme Court had decided that the amount of nitric acid produced by the Alsop process was negligible and perfectly harmless. The facts in the case are that the Western District of the United States Circuit Court of Appeals has reversed the decision of the lower court in the case of the United States versus Kansas Mill & Elevator Company on its instructions to the jury both on the questions of adulteration and of misbranding. The case has been remanded for a new trial and the United States Supreme Court has granted the motion for a review. The case has been set down for hearing on October 14 next, immediately after the case heretofore assigned for that date.

Hydroelectric Project in Tasmania.

In the middle of the island of Tasmania, at an altitude of 3,400 feet, there is a great natural storage reservoir for water known as Great Lake. It has an area of 41 square miles and an outlet through the River Shannon.

A company has been formed to develop the available water power and will divert the water from the Shannon River so as to obtain an effective fall of 1,000 feet. The power house will be built for generating electricity and it is expected to develop 85,000 horsepower at all seasons of the year. Current will be supplied to Hobart and Launceston, the two principal towns of the island, and to the important mineral region along the west coast.

INSULATED AND BARE COPPER AND ALUMINUM CABLES FOR THE TRANSMISSION OF ELECTRICAL ENERGY, WITH SPECIAL REFERENCE TO MINING WORK.[1]

By Burkewood Welbourn.

While copper is a well understood and consistently reliable metal, and standard cables, fittings, etc., have been worked out for it, and the disposition undoubtedly is to leave well enough alone, there is no inherent electrical reason why insulated aluminum conductors should not be used for all purposes and at all working pressures. The writer believes that there will be little disagreement with his own conclusion as regards the use of copper or aluminum, namely, that every case should be settled on its merits. Usually, this will resolve itself into a question of a strict comparison of the cost of the rival systems. The matter is worth close investigation, as the transmission of the current may account for 50 per cent of the cost of the electrical equipment of a mine.

The world's annual production of copper is about 1,004,485 tons, and aluminum approximately 60,000 tons. Aluminum has not made any serious impression on the use of copper for electrical work. Only about 15 per cent or, say, 10,000 tons, of all the aluminum produced is so used, and it will be seen later that this is only equivalent to 20,000 tons of copper. It is known that further plants are now being constructed which will increase by 50 per cent the present output of aluminum within the next two or three years; and, as improvements in manufacturing methods are likely to reduce the cost of production, a reduction in the selling price should follow, and result in a considerable increase in its use for electrical work, unless a corresponding reduction is made in the price of copper.

The Properties of Copper and Aluminum Compared.

Electrolytic copper-wire bars contain about 0.2 per cent of impurities. Aluminum bars usually contain 0.5 to 0.7 per cent of impurities (chiefly silicon and iron), and these should never exceed 0.71 per cent, at which figure the conductivity of hard-drawn aluminum is 60 per cent when compared with the British standard for hard-drawn copper at 60° Fahrenheit; with 0.5 per cent of impurities the conductivity will be as high as 61.7 per cent. If the impurities do not exceed 0.75 per cent, as can invariably be arranged, then the writer is of opinion that bare aluminum wires can be used in the United Kingdom in any situation in which copper wires can be employed.

1 Portion of a paper read before the Institution of Mining Engineers in London, Eng., June 5.

It has been frequently stated that aluminum is quite unsuitable for use on overhead lines on the coast, because of the salt spray. This, no doubt, is true if aluminum alloy is used; but if aluminum of the purity previously mentioned is employed, no more corrosion will take place than with copper, as is shown by the present condition of the aluminum cable, which has been in use on an overhead line at Larne Harbor, County Antrim, for about 10 years. Aluminum will not withstand hydrochloric acid or alkaline solutions, but it is extremely unlikely that such chemicals would be found in any situation in which an overhead line should be used. For lines near coke-ovens, aluminum should always be used, as it resists the action of sulphur-dioxide products, whereas copper will not do so. It is well known that when cables are insulated with vulcanized bitumen or rubber, the outside layer of the wires must be tinned to prevent the action on the wires of the sulphur employed in the vulcanizing process. When aluminum is sustituted for copper, no such precaution is needed, as it is not acted on by sulphur.

In Table I the electrical conductivity of copper and aluminum is compared:

TABLE I.—COMPARISON OF ELECTRICAL CONDUCTIVITY OF COPPER AND ALUMINUM.

	Copper.	Aluminum.
Conductivity for equal section	1.00	0.60
Section for equal conductivity	1.00	1.666
Diameter for equal conductivity	1.00	1.29
Weight for equal conductivity	2.00	1.00
Weight for equal bulk	3.30	1.00

If equal sections of copper and aluminum are tested *under equal conditions*, it will be found that an aluminum conductor will carry 60 per cent of the current that a copper conductor will carry with the same loss of energy. Conversely, the cross-section of an aluminum conductor must be 1.666 times that of a copper conductor if it is to carry the same current with equal drop of pressure.

The co-efficient of linear expansion per degree Fahrenheit is 40 per cent greater for aluminum than for copper. So far as the author is aware, this has not been a source of difficulty, but it is evident that provision should be made for the expansion of insulated aluminum conductors, if they are to be worked up to their full current-carrying capacity, as, with insulated cables, heat is not rapidly dissipated. With uncovered aluminum cables, however, the dissipation of heat is more rapid than with copper cables, as on account of their greater diameter the radiating surface is greater. The difference is sometimes as much as 10 per cent.

Annealed metals are employed for the conductors of insulated cables, and are not used under tensile stress, so that their

tensile strength is of no importance; the strength is, however, all important for overhead lines, and hard-drawn conductors must always be used for them. The strength of hard-drawn copper and aluminum varies widely, and depends on whether the material is hot-rolled or cold-rolled. Hot-rolled copper gives sufficiently good results for all purposes which are being considered, but aluminum for overhead lines should always be cold-rolled, despite the greater expense. Cold-rolling, coupled with improved manufacturing processes in England, has increased the breaking strain of aluminum by 10 per cent over that obtained only three years ago. As this result has considerable bearing on the design of overhead lines, it is suggested that individual wires for such lines should be specified to comply *after stranding*, with the test given in Table II., without interfering with the electrical conductivity already mentioned.

TABLE II.—SUGGESTED TESTS FOR HARD-DRAWN ALUMINUM CONDUCTORS.

Standard Wire Gauge.	Diameter of Wire.	Breaking-strain.	Extension on a 5-inch Length.	Wrapping Test.
	Inches.	Tons per Sq. In.	Per cent.	
4	0.232	11.00	3.00	Three times round its own diameter and three times off.
6	0.192	12.00	3.00	
8	0.160	13.00	3.00	
10	0.128	13.50	3.00	
12	0.104	14.00	2.50	
14	0.080	14.50	2.50	
16	0.064	14.75	2.50	

It will be noticed that no suggestion is made in Table II as to what the limit of elasticity (yield-point) should be. For aluminum it is usually assumed to be 70 per cent of the ultimate breaking strain, and, for copper, 75 per cent.

On a large number of wires of diameters of 0.201, 0.142, and 0.135 inch, respectively, the average breaking load was 14 tons per square inch, the limit of elasticity 10 tons per square inch, and the extension 4.5 per cent after stranding.

The Transmission of Electrical Energy.

For transmitting electrical energy for mines, both copper and aluminum may be employed—

(A) as insulated conductors in the form of cable for use below ground.

(B) as bare or braided conductors suspended on insulators on an overhead line on the surface.

Insulated Cables.

Up to the present time copper conductors for insulated cables have had almost a monopoly in this country, both for high and low-pressure work, and there appears to be no case in the United Kingdom in which aluminum cables have been used for shaft or in-bye work in a mine. In mines, except for electric-lighting distribution circuits, cables are almost invariably insulated with impregnated paper, or bitumen, and they are usually protected with wire armor and compounded tapes of jute.

The armor is used for:

(1) Mechanical protection and for relieving the strain on a cable when suspended or when a "fall" occurs.

(2) Providing an earthed conductor to surround the cable for the prevention of shock in the event of a fault, by carrying any leakage current directly back to the controlling switchboard, and insuring the immediate cutting off of supply from the faulty cable or apparatus.

(3) Assisting in preventing open sparking. In the case of paper-insulated cables, a lead sheath is frequently employed below the armor to keep the paper dry, and it, also, materially assists in the prevention of open sparking, and is therefore to be preferred to a bitumen sheath.

Some stress is laid on the use of armor, because the diameter of aluminum cables is greater than that of the equivalent copper cables; hence the cost of protecting an aluminum cable exceeds that of a copper. Compounded tapes or jute strings are used to protect the armor, etc., from corrosion, and should be impregnated *in vacuo* with a flexible waterproof compound before application to the cable. Investigation of cables protected with jute string shows that the jute opens at bends in the cable and allows the water of the mine, often corrosive, to have access to the armor. The writer is of opinion that compounded hessian tapes afford much more certain protection than jute string. Too much stress need not be laid on the corrosive action of water, provided that the best modern armored and taped cables are employed; but, undoubtedly, fair samples of the mine waters should always be analyzed by an experienced chemist before a final decision is taken as to the cable to be installed. The chief corrosive agents to be guarded against in vulcanized-bitumen cables are (1) caustic soda, due to the electrolysis of salt on the occurrence of a leakage of direct current; (2) lime in concrete and mortar; and (3) alkaline waters, due to calcium carbonate.

With regard to lead-sheathed cables, there are very few corrosive agents which will attack lead. Those which do so form a protective coating on the lead, if not subjected to external electrolysis. There have been a few cases of corrosion of lead sheathing in mines, but expert examination always reveals (1) that the corrosion is the result of chemical action aided by electrolysis, and not of chemical action alone; (2) that corrosion is almost confined to direct-current circuits only; or (3) that the lead has not been made continuous and connected to earth. In two-phase and three-phase work, the writer has never known a case of electrolytically corroded lead, and if such corrosion occurs at all, it must be very rare. It can be said, with entire confidence, that corrosion of the lead sheathing due to electrolysis cannot occur on alternating or direct-current circuits if the Home Office requirements for the continuity and earthing of the lead and armor on cables are adhered to.

The writer has no desire, on the present occasion, to reopen the controversy between the advocates of paper and bitumen insulation. He would only plead for the very highest standard of cable work in mines, whether copper or aluminum conductors are used, and indicate his personal preference for paper-insulated lead-sheathed cables. It may be taken as a general rule that such cables amply repay all the care in manufacture and installation that may be lavished on them. They will then form the most reliable part of the electrical installation, just as they have proved to be in traction, power, and lighting undertakings.

Cables with Aluminum Conductors.

Seeing that aluminum cables have not been used in mines in this country, it is necessary to examine the evidence for them critically. Apart from several short lengths of aluminum cables, the most important cases in which they have been used in this country are as follows, and it is within the author's knowledge that they work quite satisfactorily.

(1) The Manchester Corporation Electricity Department has over 11,000 yards of single-core paper-insulated lead-sheathed cable in use, chiefly of 1.66 square inch area, at varying pressures up to 600 volts as direct-current traction and lighting feeders. Some of the cable has been in use for nearly four years.

(2) The Bolton Corporation Electricity Department has had 1,440 yards of single-core 1.66 square inch paper-insulated lead-sheathed cable in use as low and medium-pressure direct-current feeders for over three years.

(3) The Metropolitan Electric Supply Company, Limited, London, has in use about 6,000 yards of 0.83 square inch medium-pressure concentric and triple concentric paper-insulated lead-sheathed cable.

Other users of aluminum cables include the County of London Electric Supply Company, Limited, Ealing Corporation, and the Stanton Iron Works Company, Limited.

In Europe, chiefly in France, Germany and Switzerland, extensive use has been made of these cables in the streets. The writer has seen a list of places in which over 800 miles of cable are employed at voltages varying from 240 to 60,000 (single-phase). The City of Zurich alone has 238 miles, while the Paris General Omnibus Company has in use armored single-core tramway feeder-

TABLE III.—COMPARISON OF PRICES OF MEDIUM-PRESSURE THREE-CORE COPPER AND ALUMINUM CABLES WITH PAPER INSULATION AND LEAD SHEATH.

Description.	(1) Plain lead-sheathed. 0.10 square inch three-core Copper.	(1) Equivalent Aluminum.	(2) Single-wire armored. 0.10 square inch three-core Copper.	(2) Equivalent Aluminum.	(3) Double-wire armored. 0.10 square inch three-core Copper.	(3) Equivalent Aluminum.
When aluminum wire bars are $107 per ton above the price of copper wire bars....	1.00	1.00	1.00	1.035	1.00	1.055
When aluminum bars are $49 per ton above copper bars	1.00	0.96	1.00	1.00	1.00	1.03
When aluminum and copper bars are the same price per ton..	1.00	0.93	1.00	0.98	1.00	1.00
When aluminum bars are $49 per ton below copper bars	1.00	0.90	1.00	0.95	1.00	0.98

cables involving the use of 300 tons of aluminum, and has on order cables amounting to a further 300 tons. There seems to be, therefore, sufficient evidence already in existence to justify the use of aluminum cables where there is a saving in cost.

Comparison of Prices of Insulated Copper and Aluminum Cables.—At the time of writing this paper (March, 1913) the market values prevailing have been used in working out the comparative prices of insulated cables as follows,

Copper (electrolytic wire bars), per ton of 2,240 pounds.....$337

Aluminum (electrolytic wire bars), per ton of 2,240 pounds.....$440

The price of copper stated above is about 5 per cent higher than the average price for the last 15 years, during which period it has fluctuated between $262 and $592 per ton. On the other hand, aluminum has fallen from about $970 per ton to the above figure.

In order to make an effective comparison between the prices of insulated cables with copper and of those with aluminum conductors, it will be convenient to consider fully some types and sizes of cables which are commonly employed in three-phase and direct-current work.

For *three-phase work* at low and medium pressures a 0.10-square-inch three-core paper-insulated lead-sheathed cable with copper conductors has been selected. The equivalent aluminum cable will, as has been seen, have a sectional area of 0.166 square inch. The cables under comparison are designed to comply with the Engineering Standards Committee's specification of March, 1910. In Table III. those under divisions (2) are suitable for in-bye use; while those under division (3) are for shaft or in-by use, and will, in all cases comply with requirements of the Home Office.

From Table III. it will be seen that the aluminum cable is the cheaper:

(*a*) *in plain lead-sheathed cables* whenever aluminum wire bars are less than $107 per ton above the price of copper bars; (*b*) *in single-wire armored cables* whenever aluminum wire bars are less than $49 per ton above the price of copper bars; (*c*) *in double-wire armored cables* whenever aluminum wire bars are lower in price than copper bars.

For direct-current work, at low and medium pressures, a similar comparison will be found in Table IV between a 0.30-square-inch copper single-conductor paper-insulated lead-sheathed cable and the equivalent 0.50-square-inch aluminum cable, both being built to comply with the Home Office rules.

TABLE IV.—COMPARISON OF PRICES OF MEDIUM-PRESSURE SINGLE-CORE COPPER AND ALUMINUM CABLES WITH PAPER INSULATION AND LEAD SHEATH.

Description.	(1) Plain lead-sheathed. 0.30 square inch Copper.	(1) 0.50 square inch Aluminum.	(2) Single-wire armored. 0.30 square inch Copper.	(2) 0.50 square inch Aluminum.	(3) Double-wire armored. 0.30 square inch Copper.	(3) 0.50 square inch Aluminum.
(a) When aluminum-wire bars are $204 per ton above the price of copper-wire bars	1.00	1.00	1.00	1.043	1.00	1.07
(b) When aluminum bars are $107 per ton above copper bars	1.00	0.92	1.00	0.983	1.00	1.015
(c) When aluminum bars are $49 per ton above copper bars	1.00	0.89	1.00	0.955	1.00	0.99
(d) When aluminum and copper bars are the same price per ton	1.00	0.855	1.00	0.930	1.00	0.97
(e) When aluminum bars are $49 per ton below copper bars	1.00	0.825	1.00	0.903	1.00	0.945

Table V is similar to Table IV, and gives a comparison of the same conductors but bitumen-insulated, etc., so as to comply with the Home Office rules.

Attention should be particularly directed to the comparative figures for unarmored cables in division (1) of Tables III, IV and V, because there are installations where economies can be effected by using such aluminum cables on the surface works only, especially when the generating station or substation is situated at any considerable distance from the shaft. It should be stated briefly, also that with larger sizes of unarmored direct-current cables, the saving is greater than is shown in Tables IV and V, and that unarmored concentric and triple concentric aluminum cables for pressures up to 650 volts usually show a considerable saving over the equivalent copper cables. One such case came under notice this year, where a triple concentric aluminum cable showed a saving of

TABLE V.—COMPARISON OF PRICES OF MEDIUM-PRESSURE SINGLE-CORE COPPER AND ALUMINUM CABLES WITH BITUMEN INSULATION.

Description.	(1) Braided only. 0.30 square inch Copper.	(1) 0.50 square inch Aluminum.	(2) Single-wire armored. 0.30 square inch Copper.	(2) 0.50 square inch Aluminum.	(3) Double-wire armored. 0.30 square inch Copper.	(3) 0.50 square inch Aluminum.
(a) When aluminum-wire bars are $204 per ton above the price of copper-wire bars	1.00	1.00	1.00	1.033	1.00	1.05
(b) When aluminum bars are $107 per ton above copper bars	1.00	0.93	1.00	0.98	1.00	1.005
(c) When aluminum bars are $49 per ton above copper bars	1.00	0.90	1.00	0.955	1.00	0.985
(d) When aluminum and copper bars are the same price per ton	1.00	0.865	1.00	0.93	1.00	0.965
(e) When aluminum bars are $49 per ton below copper bars	1.00	0.835	1.00	0.91	1.00	0.945

TABLE VI.—COMPARISON OF PRICES OF 3,000-VOLT THREE-CORE COPPER AND ALUMINUM CABLES.

	(a) 0.20 square inch Copper.	(b) 0.333 square inch Aluminum.
(1) Price	1.00 (unity).	1.11
(2) Net weight of length in pounds	14,400	16,100
(3) Size of drum	7 feet 8 inches in diameter by 3 feet 10 inches in width.	8 feet 2 inches in diameter by 3 feet 10 inches in width.
(4) Overall diameter	2.70 inches.	3.07 inches.
(5) Capacity in microfarads per mile at 60 degrees Fahrenheit; one core to others and the sheath	0.70	0.80

20 per cent over the corresponding copper cable.

For 3,000-volt three-phase cables a similar close investigation has not been made, but it is instructive to examine the case of a 0.20-square-inch paper-insulated three-core 3,000-volt copper conductor lead-sheathed and double-wire armored cable 470 yards long which was supplied to a colliery company, and to compare it with the equivalent aluminum cable. Table VI sets out the comparative prices and details of this cable and of the corresponding aluminum cable as at March, 1913.

TABLE VII.—3,000-VOLT THREE-CORE DELTA CABLES.

Sectional Area.	0.10 square inch Copper.		0.167 square inch Aluminum.		0.20 square inch Copper.		0.333 square inch Aluminum.	
Class.	*	†	*	†	*	†	*	†
Price	1.00	1.00	0.96	1.02	1.00	1.00	1.04	1.11
Approximate net weight per 470 yards, in hundredweight	51	95	55	111	81	144	86	161

*Plain lead-sheathed cable.
†Double-wire armored and tape-protected cable.

This table clearly shows that the aluminum cable cannot compete in this case either in price or in weight. In the above example, if plain lead-sheathed cables had been permissible, the aluminum cable would have cost four per cent more than the copper cable. It is instructive also to compare the prices of cables exactly similar to the foregoing, but with 0.10-square-inch copper and 0.167-square-inch aluminum conductors. With a plain lead sheath, the aluminum cable would cost four per cent less than the copper cable, but with double-wire armoring, the cost would be two per cent more. These figures and the weights of the cables are set out in Table VII.

Frequently it is decided in three-phase mining work to earth the neutral point of the system, and so reduce the working pressure between the conductors and the earth. This enables changes to be made in the design of cables which work at 2,000 volts and higher pressures, with consequent saving in first cost. At 2,000 and 3,000 volts three-core cables built for star working are cheaper than cables for delta working by about 0.5 per cent on small cables of 0.025 square inch, and by about 1.5 per cent on cables of 0.30 square inch. At 6,600 volts, the corresponding savings would be 3.00 and 10.00 per cent approximately.

Comparison of Weights of Insulated Copper and Aluminum Cables.—Supplementing the information already given for 3,000-volt cables, Table VIII gives some comparative data for different types of low and medium-pressure vulcanized-bitumen double-wire armored cables (both with copper and aluminum conductors) which can be accommodated on a cable-drum not exceeding 4.5 feet in diameter and 3 feet between the flanges. This information should be of assistance in planning out work below ground. Similar figures would hold good for paper-insulated lead-covered double-wire armored cables, which are usually smaller in diameter than vulcanized-bitumen-insulated cables, although somewhat heavier.

TABLE VIII.—COMPARATIVE DATA FOR DIFFERENT TYPES OF LOW AND MEDIUM-PRESSURE VULCANIZED-BITUMEN DOUBLE-WIRE ARMORED CABLES, WITH COPPER AND ALUMINUM CONDUCTORS RESPECTIVELY.

	Size of Drum.			Copper Conductors.		Aluminum Conductors of Equivalent Section.	
Sectional Area of Cable.	Barrel.	Flange.	Width between Flanges.	Length of Cable on Drum.	Approximate gross weight of Cable on Drum.	Length of Cable on Drum.	Approximate gross weight of Cable on Drum.
Square inch.	Inches	Inches.	Inches	Yards.	Cwts.	Yards.	Cwts.
0.025 single	20	42	36	570	25	512	23.5
0.025 twin	24	42	36	227	20	187	19
0.025 three core	24	42	36	198	20.5	170	19
0.050 single	20	42	36	490	25.5	438	24
0.050 twin	27	42	36	144	17.25	114	16.25
0.050 three core	27	42	36	126	18.25	105	16.25
0.100 single	24	42	36	330	22	265	19.5
0.100 twin	33	45	36	88	15.5	69	14.5
0.100 three core	33	45	36	78	16.5	61	14.5
0.250 single	27	42	36	190	20.25	166	18.75
0.250 twin	40	54	36	84	24	65	20.5
0.250 three core	40	54	36	76	25	58	20

Overhead Lines.

As with cables, overhead lines should be constructed with the best available materials and workmanship throughout, and then they will prove to be very reliable in practice. Usually they are considerably cheaper than insulated cables, and the saving that may be effected frequently is as much as 50 per cent.

For overhead lines the copper or aluminum employed must be hard-drawn, and it is customary to use a stranded conductor, because its breaking-strain is greater than for a solid conductor of equal cross-sectional area. It is also usual to employ the smallest practicable number of wires in a strand so that each wire may be made to take its proper share of the longitudinal stress; but it is not advisable to use any aluminum wire exceeding 0.25 inch in diameter; and in conductors up to 0.25 square inch no individual wire should exceed 0.169 inch in diameter. Wherever it is desired to protect either metal from corrosion, etc., servings of single, duplex, or treble weather-proof compounded braid should be provided. In these cases, the extra windage surface of the lines, their increased weight, and possible extra collection of snow, should be allowed for in designing the poles, etc.

There are legitimate differences of opinion as to factors of safety for copper and aluminum wires. The practice varies widely: for example, in North America, where both aluminum and copper overhead lines are extensively used, the maximum stress employed for both copper and aluminum is 250 per cent greater than is called for in the British Board of Trade regulations. Making allowance for the elasticity of the metals, experience shows that in most parts of the United Kingdom it is sufficient to allow 17 pounds per square foot of wind pressure and a factor of safety of 3.5

TABLE IX—COMPARISON OF COSTS OF COPPER AND ALUMINUM TRANSMISSION LINES.

Details.	Copper.	Aluminum.
Strand	7/0.136	12/0.134
Span, in feet	200	200
Summer sag, in feet	3.6	4.8
Ground clearance, in feet	22	22
Distance apart of wires, in feet	3	4
Height of pole above ground, in feet	29	32
Depth of pole in ground, in feet	6	6
Total length of pole (taking standard size), in feet	36	38
Number of poles per mile	27	27
Diameter of single poles at 5 feet from butt at 17 pounds per square foot wind pressure and factor of safety of 8 for poles, 3.5 for copper, and 4.5 for aluminum, in inches	11.25	12.25

The cost of materials and erection per mile of the above line with wires and brackets would be as follows:

	Copper.	Aluminum.
27 creosoted wooden poles with brackets and insulators	$ 621	$ 710
3 miles of conductors erected (copper, 6,330 pounds; aluminum, 3,210 pounds)	1400	972
Total cost	$2021	$1682

This shows an approximate saving of 16.5 per cent in favor of aluminum.

for copper and 4.5 for aluminum at a temperature of 22 degrees Fahrenheit when metals are employed which are of the quality suggested in this paper.

Comparison of Costs of Copper and Aluminum Lines.—The first cost of overhead transmission lines of stranded aluminum conductors of 0.10 square inch sectional area and upwards, with spans up to 400 feet (the maximum usually employed in the United Kingdom), is less than for lines of copper conductors. A comparison of the cost of a 6,600-volt three-phase 25-cycle line to carry 1,000 kilowatts for 10 miles under British conditions, constructed of copper and aluminum, is given in Table IX.

Experience has shown in North America that there is much less trouble with aluminum than with copper from ice and snow collecting on the conductors; and if in the future it can be demonstrated that aluminum does not collect these as readily as copper does in this country, then modifications in pole design, etc., will follow, with a further saving in cost in favor of aluminum. Aluminum conductors, being very light and of larger diameter than copper, are blown up vertically as well as horizontally in strong gusts of wind, and they require to be amply spaced, which increases the cost. So far as the author knows, copper wires in this country are never blown in any other direction than sideways.

Jointing of Conductors.

On Insulated Cables.—The author would offer this warning on the jointing of insulated aluminum cables. So far as his experience goes, there is not a single solder which is permanently satisfactory, and he cannot recommend either cast-aluminum joints or autogenous welding, owing to the effect of the heat on the insulation. But he can confidently recommend mechanical joints.

On Overhead Lines.—Usually, in this country joints on copper and aluminum conductors on overhead lines are made at an insulator, so as not to be under stress. Copper joints can be easily made in various ways. Probably the best method on overhead lines, or on insulated cables carrying any considerable current, is by means of flexible copper braid bound and soldered to the joint.

There are various ways of jointing aluminum conductors on overhead lines, among which may be mentioned the following:

(1) Up to 0.25 square inch, welded joints can be made by making the ends butt inside a metal sleeve and heating them by means of a blow-lamp until the ends can be forced together by hand. After cooling, the metal sleeve is then removed. This type of joint must not be subjected to stress. It was used throughout on the Aldershot lines, and has proved entirely satisfactory, its conductivity being higher per unit length than that of the hard-drawn conductors themselves. It is also being used for some of the lines under construction for the War Office on Salisbury Plain.

(2) Another way of jointing large conductors is by means of a straight-through clamp-joint. Such a joint cannot be used under stress, and it should be painted, immediately after fixing, with a high-class paint, in order to prevent oxidation of the strands inside the clamp.

(3) A torsion sleeve-joint may be employed for jointing conductors up to about 0.30 square inch, under strain. It has not been much used in this country, but it is commonly employed in the United States and Canada, and is understood to be satisfactory. It should be painted.

(4) A specially designed joint for use under stress was employed on Newton Chambers & Company's 1.4-square-inch line. To prevent electrolytic action, the steel holding-bolts were stoved and enameled. It should be painted.

Arguments Against Aluminum Conductors.

Two frequent arguments against the use of aluminum are (*a*) that aluminum has an uncertain scrap value; and (*b*) that there are considerable difficulties in jointing the metal satisfactorily. This latter point has already been dealt with. In regard to (*a*), at one time there was a difficulty in selling scrap aluminum, but now there is none. Clean, commercially pure aluminum scrap, as obtained from cables or from overhead lines, can readily be sold at about 5 cents per pound below the market price of aluminum-wire bars, whereas the price of clean electrolytic copper scrap is about 1.3 cents per pound below the price of wire bars.

The writer is aware of three cases in which aluminum conductors were erected in the United Kingdom during the past ten years, with unsatisfactory results, and has been at some pains to investigate them. He is of opinion that these failures were solely due to (*a*) inferior metal and insufficient knowledge of working it at the time: these causes no longer exist; (*b*) inexperience in erection. There is now, however, sufficient experience to draw upon, so that there need be no fear of difficulties from this cause.

Summary.

(1) Up to the present, aluminum has not made any serious impression on the use of copper for electrical work in the United Kingdom, but it is coming increasingly into favor.

(2) The initial difficulties in regard to the purity of aluminum, methods of working it, etc., have been overcome, and it can be safety used, as a conductor, on an equal footing with copper.

(3) For *mining* work in the United Kingdom, at the present prices of copper and aluminum, insulated cables with copper conductors and for all pressures are the cheaper, while, for overhead lines, aluminum conductors are the cheaper.

(4) Paper-insulated lead-sheathed cables are cheaper than bitumen-insulated cables, whether the conductors be of copper or of aluminum.

(5) Both copper and aluminum conductors can be efficiently jointed by well proved methods.

TABLE X.—COMPARISON OF THE PHYSICAL, MECHANICAL, AND ELECTRICAL PROPERTIES OF ALUMINUM AND COPPER.

Property.		Aluminum.	Copper.
Electric conductivity (silver = 100)		58.5	97.5
Coefficient of linear expansion per degree Cent.		0.0000245	0.0000167
Coefficient of linear expansion per degree Fahr.		0.0000136	0.0000093
Specific gravity, cast ingots		2.706	8.78
Specific gravity, rolled or drawn		2.71	8.95
Tensile strength in pounds per square inch—No. 4-No. 16 S. W. G.		24,600 to 33,000	55,700 to 62,500
Tensile strength in kilograms per square millimeter		17 to 23	38 to 44
Elastic limit (yield point) as per cent of tensile strength		70	75
Modulus of elasticity, in pounds per square inch		9,800,000	16,000,000
Modulus of elasticity, in kilograms per square millimeter		6,905	11,200
Specific resistance in microhms per cubic centimeter at 60 degrees Fahrenheit (15.5 Centigrade)	Soft	2.827	1.696
	Hard	2.884	1.730
Specific resistance, in microhms per cubic centimeter at 0 degrees Centigrade (32 Fahrenheit).	Soft	2.667	1.600
	Hard	2.768	1.660
Resistance of conductor 1,000 yards long by 1 square inch in cross-section	Soft	0.04008	0.02404
	Hard	0.04089	0.02453
Coefficient of increase of resistance with temperature	Per degree Centrigrade	0.0032 to 0.0040	0.0038 to 0.0043
	Per degree Fahrenheit	0.0018 to 0.0022	0.0021 to 0.0024
Weight per 1,000 yards by 1 square inch nominal section, in pounds		3,520	11,700
Weight per 100 feet by 1 square inch nominal section, in pounds		117.3	392

Development of Iceland's Water Power.

The Nitrogen Products & Carbide Company, an English concern, has closed contracts for the purchase of Dettifalls, the largest waterfall in Iceland situated about 35 miles from the seacoast in the River Tokulsa, which flows over northern Iceland for 100 miles and empties into the Arctic Ocean. The company will erect large works and construct a railway from the coast to the falls. Fertilizer will be produced, and the plant will require some 400,000 horsepower. The water power available at the falls purchased is estimated at 410,000 horsepower, and much more can be obtained in the vicinity if needed. The falls were purchased from four Icelandic peasants.

Government Radio Instructions.

The Bureau of Navigation, Department of Commerce, has issued a new set of instructions under the date of July 1, 1913, which supersedes all former editions of "Regulations Governing Radio Communication."

Transformer Capacity for Induction-Motor Feeder Circuits.

The question as to the nature of the load—inductive or non-inductive, which is to be placed on the various feeders of a supply system determines to a large extent the regulating capabilities which must be provided in the design of the generator and switchboard equipment. The same matter also comes up in selecting the substation equipment, and affects the transformer capacity and connections. Thus, while with a noninductive load, such as incandescent lamps, the regulation of transformers may be within three per cent, with an inductive load the drop in potential between no load and full load may increase to about five per cent. If the motor load is large and fluctuating and close regulation is important, it is desirable to use separate transformers for the motors.

TABLE I.—SINGLE-PHASE TRANSFORMER VOLTAGES.

Voltage of Circuit	110-volt Motor.		220-volt Motor.	
	Primary.	Sec'dy.	Primary.	Sec'dy.
1100	1100	122	1100	244
2200	2200	122	2200	244

For the operation of induction motors from three-phase systems, three single-phase transformers or one three-phase unit are reccommended, although if desired two single-phase transformers may be used. The use of the three-phase transformer greatly reduces the space required and makes the wiring very simple; while the only advantage gained in using three single-phase transformers rather than a three-phase transformer is that in the case of one transformer burning out, the other two may be used to operate the motor at reduced load.

As an approximate rule it may be said that for the larger motors the capacity of the transformers in kilowatts should equal the output of the motor in horsepower. Thus a 50-horsepower motor requires 50 kilowatts in transformers. Small motors should be supplied with a somewhat larger transformer capacity, especially if (as is desirable) they are expected to run most of the time near full load, or even at slight overload. Transformers of less capacity than those given in Table II should not be used even when a motor is to be run at only partial load. The current taken by motors of higher voltage will be proportionally less than that given in Table III. The table gives average current values which may vary slightly from the actual values.

TABLE II.—CAPACITIES OF TRANSFORMERS FOR INDUCTION MOTORS.

Size of Motor H. P.	Kilowatts per Transformer. 2 Single-Phase Transfmrs.	3 Single-Phase Transfmrs.	1 Three-Phase Transfmrs.
1	0.6	0.6	
2	1.5	1.0	2.0
3	2.0	1.5	3.0
5	3.0	2.0	5.0
7½	4.0	3.0	7.5
10	5.0	4.0	10.0
15	7.5	5.0	15.0
20	10.0	7.5	20.0
30	15.0	10.0	30.0
50	25.0	15.0	50.0
75	40.0	25.0	75.0
100	50.0	30.0	100.0

TABLE III. — CURRENT TAKEN BY THREE-PHASE INDUCTION MOTORS AT 220 VOLTS.

H. P. of Motor.	Approx. Full Load Current.	H. P. of Motor.	Approx. Full Load Current.
1	3.2	20	50
2	6.0	30	75
3	9.0	50	125
5	14.0	75	185
10	27.0	100	250
15	40.0	150	370

Up to and including 5 horsepower squirrel-cage motors are started by simply closing the switch without any starting device. At starting, these motors require from four to five times full-load current and give about 1.25 times full-load torque. Motors with self-contained rotor resistance (built in sizes of 10 horsepower and over) require at starting about the same current for a given torque that would be required when running. As the resistance is cut out, the torque and the current will increase practically in the same proportion until a maximum of about two or three times full-load torque is reached.—*From the General Electric Review.*

Electrons and Electric Current.

That an electric current in metals is carried by electrons is claimed to be proved by O. W. Richardson, professor at Princeton University, by some experiments recently described in *Science.*

The experiments were carried on with a filament of incandescent tungsten in an evacuated chamber. It is well known that metals at high temperatures give off charged particles which have been designated as thermions. These thermions carry a negative charge away from the conductor and at high temperatures this loss of charge is sufficient to constitute a measurable current. The ions can be collected on a surrounding conductor and the amount of the discharge measured.

In the experiments referred to the various possible means of accounting for this emission are considered and it is demonstrated that it cannot be due to the evolution of gas, to chemical action, or to any process involving consumption of the tungsten. It is, therefore, concluded that the electrons must flow into the tungsten from outside points of the circuit, and this is considered an experimental proof of the electron theory of conduction.

MECHANICAL CHARACTERISTICS OF LONG SPANS.

By A. R. Zahorsky.

In very long spans, such as are used for river crossings, in which high steel towers are employed to obtain an allowable clearance of the transmission line above the water surface, it has been found advantageous to supplement the long span by a shorter one at either end known as the anchor span. As in suspension-bridge work, upon the high towers the cable rests upon rollers, upon insulated saddles which give it freedom to move laterally, and then extends shoreward to the anchor towers, which are built of sufficient strength to take the strain. We thus have three continuous spans of conductor in which the strain is nearly the same; the sag in one, however, is more or less dependent upon that in both of the others. It is the object of this paper to present a method of determining the sag in each of the three spans, also to what extent the cable moves laterally over the rollers upon the high towers as the sag increases.

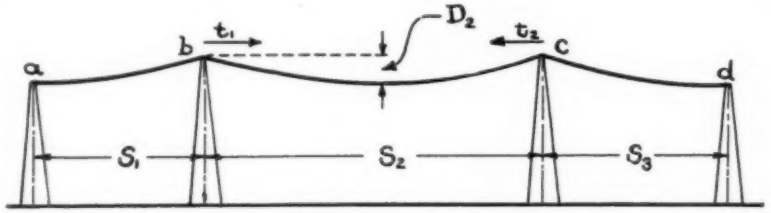


Fig. 1.—General Arrangement of Spans.

The sag and tension of a conductor in a single long span may be determined with a fair degree of accuracy if its physical constants are known and if the wire is fixed at both ends. In a triple span as described above, however, it becomes more difficult.

Sag of Cable.

In the following discussion a review will be made of the fundamental formulas for the calculation of sags and stresses of a conductor in a single span, and it will be shown how these may be made to apply to three continuous spans.

The following symbols will be used:

T = actual tension in conductor in pounds.

S = length of span in feet.

L_t = length of wire at any given temperature.

L = total length of wire in the three spans unstressed.

M = modulus of elasticity of conductor.

W = weight of conductor per lineal foot (includes wind pressure, ice, etc.).

λ = elongation of L due to stress T.

A = area of cross-section of conductor.

D = sag in feet.

The general formula for the length of

the wire in a span, based upon the parabolic equation and applicable only when the tension T is very large compared with the weight of the wire, is.

$L_t = S + 8D^2/3S$ .....(1)

The sag is given by

$D = S^2W/8\ T$ .....(2)

Equation (2) does not take care of the fact that the wire elongates due to tension.

The elongation of a conductor under stress is

$\lambda = TL/AE$ .....(3)

Let us consider three spans as shown in Fig. 1, the wire being fixed at points a and d, and allowed to move at b and c.

The lengths of the wire in the spans are

$L_1 = S_1 + 8D_1^2/3\ S_1$.....(4)

$L_2 = S_2 + 8D_2^2/3\ S_2$.....(5)

$L_3 = S_3 + 8D_3^2/3\ S_3$.....(6)

Or the total length of conductor unstressed is

$L = Q\ [L_1 + L_2 + L_3 + 8/3\ (D_1^2/S_1 + D_2^2/S_2 + D_2^2/S_3)]$.....(7)

where $Q = (1—T/AE)$

$\frac{3}{8}\ S_2\ [S_2\ K_n + K_{n-1}..K_1 + 1) —L]\ D = 3WS_2^3L/64AE$ .....(14)

where L is the total length of the wire in all the spans unstressed.

If $\propto$ is the temperature coefficient of expansion of the conductor and t is the range of temperature, then we may rewrite equation (14) thus

$D_2^3\ (K_n^3 + K_{n-1}^3..K_2^3 + K_1^3 + 1) + \frac{3}{8}\ S_2\ [S_2\ (K_n + K_{n-1}..K_2 + 1) — L\ (1 + \propto t)]\ D = 3WS_2^3L\ (1 + \propto t)/64AE$ .....(14a)

The Lateral Movement of the Conductor.

Consider, again, three spans as shown in Fig. 1. As the total length of wire increases and hence the sag, the conductor tends to move at b and c in directions indicated by the arrows t_1 and t_2. The elongation may be due to an increase in temperature, or it may be caused by the increased weight of the conductor due to an accumulation of sleet and ice.

In the following discussion we shall consider that the points a, b, c, and d, are at the same level. It has been shown by experiment that the movement of the conductor is inappreciably affected by small differences of level in a, b, c and d.

$L_1'' — L_1'$ = actual increase of wire length in span after equilibrium has been reached.

$t_1 = S_1\Delta L/(S_1 + S_2 + S_3) — (L_1'' — L_1')$ ..... (22)

Similarly

$t_2 = S_2\Delta L/(S_1 + S_2 + S_3) — (L_2'' — L_2')$ ..... (23)

Let

$S_1/S_2 = K_1$ and $S_3/S_2 = K_2$.....(24)

$D_3 = K_2^2D_2$, and $D_1 = K_1^2D_2$.....(25)

Also let $D_2'' = aD_2'$ where D_2'' is the greater sag in the middle span.....(26)

Substituting equations (15) and (20) and (24) and (25) in (21) and reducing we have

$\Delta L = 8\ (D_2^1)^2/3S_2\ [K_2^2 + K_1^2 + 1]\ (a^2 —1)$ .....(27)

From equations (18) and (15)

$L_1'' — L_1' = 8K_1^2\ (D_2^1)^2/3S_2\ [a^2 — 1]$ ..... (28)

Substituting (27) and (28) in (22)

$t_1 = 8\ (D_2^1)^2\ (a^2 — 1)/3S_2\ [K_1\ (K_2^2 + K_1^2 + 1)/(K_2 + K_1 + 1) — K_1^2]$..(29)

If there be but two spans, then $K_2 = 0$, and the equation becomes

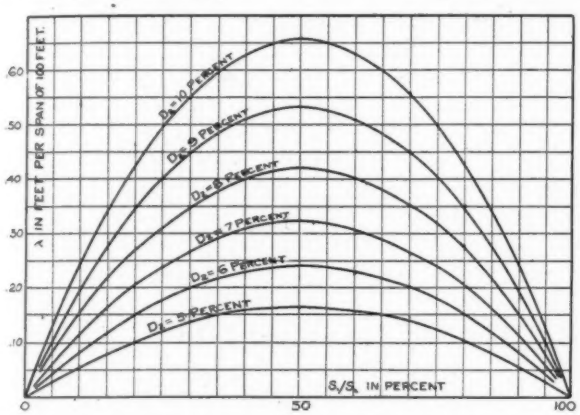


Fig. 2.—Movement of Cable Over Support for Given Sag.

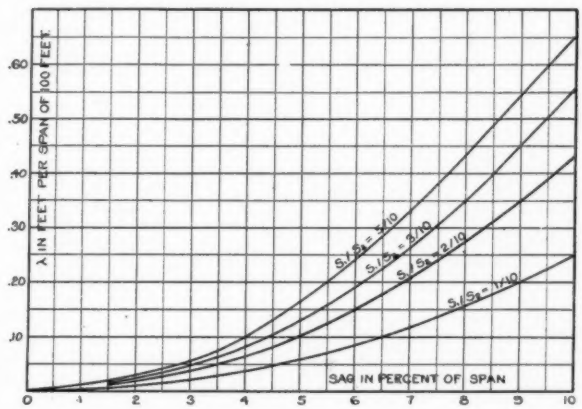


Fig. 3.—Movement of Cable Over Support for Given Ratio of Spans.

If the elongation of the conductor due to tension T is λ, then

$L + \lambda = (S_1 + S_2 + S_3) + 8/3\ (D_1^2/S_1 + D_2^2/S_2 + D_3^2/S_3)$.....(8)

where D_1, D_2 and D_3 have values greater than in equation (7)

Since we are mainly interested in the long span, S_2, from (2) we have,

$T = WS_2^2/8D_2$ .....(9)

Let

$S_1/S_2 = K_1$ and $S_3/S_2 = K_2$.....(10)

then

$D_1 = K_1^2D_2$ and $D_3 = K_2^2D_2$.....(11)

Substituting (10) (11) (9) and (3) in (8) we have,

$L + WS_2^2L/8AED_2 = S_2\ (K_2 + K_1 + 1) + (8D_2^2/3S_2)\ (K_2^3 + K_1^3 + 1)$..(12)

therefore

$D_2^3\ (K_2^3 + K_1^3 + 1) + \frac{3}{8}\ S_2\ [S_2\ (K_2 + K_1 + 1) — L]\ D_2 = 3WS_2^3L/64AE$. (13)

This is the equation for the sag in the middle span. If there are $n/2$ spans on either side of the main one, the equation reduces to the general form

$D_2^3\ (K_n^3 + K_{n-1}^3..K_2^3 + K_1^3 + 1) +$

$t_1 = 8D_2^1\ (a^2 — 1)/3S_2\ [K_1\ (K_1^3 + 1)/(K_1 + 1) — K_1^2]$.....(30)

The curves shown in Fig. 2 and Fig. 3 were obtained from equation (30). To show their application let us take the following numerical example:

Length of span S_2 = 1500 feet.

Length of span S_1 = 450 feet.

$S_1/S_2 = 450/1500 = 0.3$

Assume under normal conditions, the sag in the long span is 6 per cent of the length of span, and due to a rise in temperature the sag increases to 8 per cent. From the curves for S_2 = 6 per cent, $\lambda_1 = 0.195$, and for S_2 = 8 per cent, $\lambda_2 = 0.350$.

For a span S_2 = 100 feet.

$\lambda = \lambda_2 — \lambda_1 = 0.155$ feet.

Hence for a span of 1,500 feet, the movement would be

$t_1 = 0.155 \times 15 = 2.325$ feet.

An underground telephone cable, costing $1,500,000, is to be laid from London to Birmingham.

New Electrical and Mechanical Appliances

The New A. E. G. Searchlight.

The new electric searchlights made at the well known Berlin works of the Allgemeine Elektricitäts-Gesellschaft are to be counted among the most powerful to be as yet produced in Europe, and a beam from one of them will carry for many miles. These searchlights embody all the most recent ideas in the way of improvements, and among these is the optical part with the Jena glass concave mirrors, great skill being used in preparing the mirrors so as to have a correct surface such as is needed to keep the beam from scattering and thus to produce the needed carrying power for great distances.

As regards the electric arc itself, this is produced between carbons of unusually large diameter and is one of the most powerful yet obtained. An interesting point about the mechanism for the arc regulation is that it is operated by an electric motor through a certain number of relays on an improved method, and in this way a remarkably steady arc is produced. An improvement as to inspecting the arc consists in the use of an optical device by which the reduced image of the arc is projected camera-wise upon a ground-glass screen and is seen through red glass, so that the working of the apparatus can be observed at all times.

In the base of the searchlight are the customary electric motor devices for producing all the movements, such as rotation around the horizon and swinging upward and downward besides the operation of the eclipse shutter which covers the front of the projector; all of these movements are carried out when required, by distant control through electric cables.

Fig. 1.—New A. E. G. Electric Searchlight.

The manufacturing company has furnished some very striking views taken at night in order to show the powerful beam which the searchlights are able to produce. Fig. 2 shows the effect when the beam from the searchlight is directed upon a hill at several miles' distance from Berlin, and it will be seen that the beam lights up the objective point very brilliantly; this gives a good idea of the tremendous illuminating power of the concentrated beam. Fig. 3 shows the effect produced by a battery of searchlights assembled at the works and sending out beams in different directions.

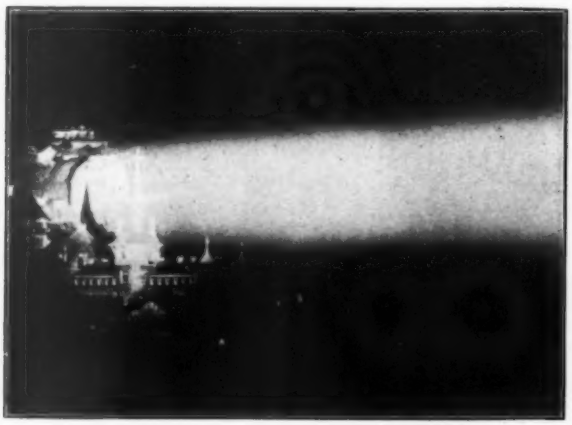


Fig. 2.—Distant Scene Illuminated by Searchlight.

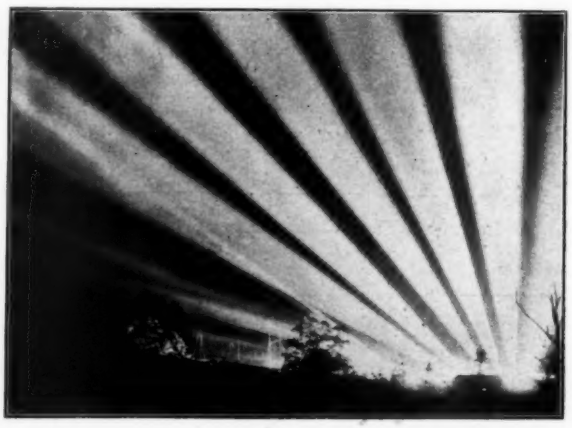


Fig. 3.—Aurora Effect Produced by Battery of Searchlights.

The Rennerfelt Arc Furnace for Producing Electric Steel.

At the Hallstahammer Iron Works in Sweden a new type of electric furnace has been put into successful use. It is known as the Rennerfelt furnace and is an improved modification of the Stassano arc furnace. The furnace already in use has a capacity of 440 pounds. Two furnaces with a capacity of 2,200 pounds and another of 440 pounds are being built for the same plant. The present furnace has a power demand of 90 to 100 horsepower.

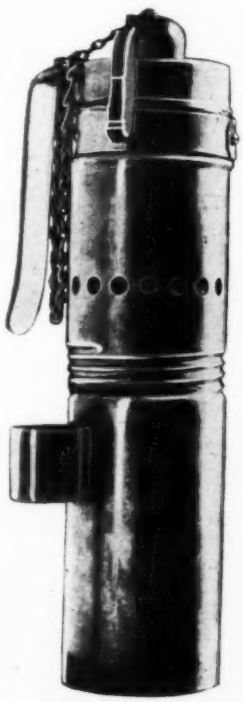
It is a cylindrical furnace with horizontal axis about which it can be turned on rollers through a considerable angle. The ends are flat and through the center of each, practically at the axis of the cylinder, passes a horizontal electrode; the third electrode is vertical and stationary, passing through the curved roof so that its arcing end is between the other two electrode points. The two side electrodes can be adjusted in a vertical direction so that the arc, which is freely burning, may be maintained closely above the surface of the charge. The electrodes are made of electrically prepared graphite.

A striking feature of the furnace is that direct current, single phase or three phase may be used. The best

voltage for the furnace seems to be 100 to 110. The furnace is lined with highly refractory magnesite bricks which permit an extraordinarily high temperature being maintained. It has been in service over seven weeks, operating about 12 hours per day; while smelting is not going on it is kept warm by a power consumption of 15 to 35 per cent of the normal operating load. The electrodes are consumed at the rate of about 5.5 pounds per ton of finished steel. The energy consumption is about 590 kilowatt-hours per ton of steel; it is expected that this will be further reduced in the larger furnaces.

A Compact Lineman's Torch.

Frank D. Booth, of Glendale, Cal., has invented a wire-joint soldering torch for which wonderful claims are made, and



Compact Lineman's Torch.

which is shown in the accompanying illustration. This torch is adapted particularly for the use of linemen in soldering wire joints, although it is not restricted to that peculiar use but may be adapted to many uses and purposes.

There are at the present time in use two forms of torches for the work described. One form is the plain alcohol wick torch and the other is the familiar form of gasoline blow torch. Either of these forms are liable to be extinguished by a high wind and are therefore untrustworthy. In addition, the gasoline torch is difficult to start while the lineman is at work on the pole, as he must descend to the ground, generate the heat for starting the torch and carry it up the pole with him while it is burning. This operation is inconvenient and dangerous and involves the expenditure of a large amount of time, if it is done each time a joint is soldered. If it is not done and the torch is allowed to burn during intervals between actual use, a large amount of fuel is wasted.

It is the prime object of the new torch to supply a device which will overcome these difficulties in a simple and efficient manner. The torch uses alcohol or other suitable fuel and provision is made for the protection of the flame from the wind. The same device which accomplishes this also concentrates the heat of the flame on the desired portion of the wire and affords a means of supporting the whole device by the wire itself and obviating the necessity of supporting the torch by hand. Provision is also made for keeping the base of the torch at a comparatively low temperature so that the fuel reservoir shall not overheat.

The torch consists of a reservoir base and a burner mounted on the base at its upper end, this burner comprising a tube extending upward from the base and having a wick in its interior extending down into the reservoir of the base. There is an inner tubular shield, detachably mounted on the base, extending upwardly therefrom around and for the protection of the burner, this shield having a series of draft openingss at its base, near the top of the reservoir base, and having apertures in its walls extending from its upper edge downwardly, these last named aperatures having upwardly and sidewardly extending extensions at their lower ends. There is also an outer tubular shield mounted on the inner shield and movable thereon, the outer shield having apertures extending downwardly from its upper edge.

Wherever used this torch has proven entirely successful. It is manufactured by the firm of Mathias Klein & Sons, Chicago, Ill. The torch is about ten inches tall, two inches in diameter and weighs about a pound.

Electric House Pumps.

The electrically operated pump is rapidly growing in favor as a means for

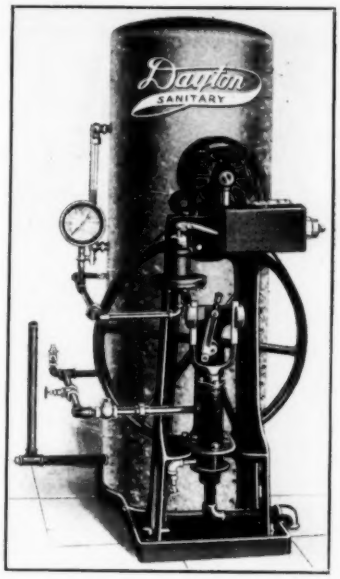


Fig. 1.—Electrically Driven House Pump.

supplying water under pressure, wherever electric current is available, and is particularly valuable in houses in rural communities where there are no water systems, and supplying soft water to bath rooms and laundries from cisterns where the water is hard or otherwise unfit. Up to within the last few years, water motors or lifts were largely used for this purpose; the former, however, have always been unsatisfactory because of low varying city water pressure and deterioration of the lift's working parts through action of grit, alkali, sulphur, etc., usually found in the city water where they are used. The electric motor-driven pump is not affected by any of these conditions; its operation is reliable, it requires very little attention, it is noiseless and is adaptable to systems of all capacities.

Electric pumping equipments are also being used for general water supply in offices and flats where the city pressure is not sufficient to supply the upper floors.

Fig. 1 shows an extensively used type of house pump, made by the Dayton Pump Manufacturing Company,

Fig. 2.—Group of Buildings Supplied by Electric Pump.

Dayton, O. It is driven by a Westinghouse small motor operated directly from the lighting circuit. This particular type of pump is used for supplying closed pressure tanks, the pressure being regulated automatically. The motor is started by an automatic switch which closes the pump-motor circuit when the pressure gets low and stops the pump when the pressure reaches a certain predetermined value.

Fig. 2 shows a group of buildings which are supplied by a pressure water system such as the one described, and this is a typical place where a motor-driven pump is a necessary adjunct. The electric pump is in a small building adjoining the power plant and furnishes the house, barn, greenhouses, etc., with a reliable supply of water. Another point to be considered is that in a location such as this, the fire risk is considerably reduced by an efficient water-supply system.

Substation Fuses for 66,000 Volts.

Among the recent developments in high-tension circuit-interrupting devices, the chemical fuse has taken high rank and its successful operation under severe conditions is rather remarkable. During the past three years the lower voltage fuses have been extensively used and many tests have been conducted on all pressures up to 33,000 volts. A recent development for use on 66,000-volt systems is shown in the accompanying illustration and the successful operation of this equipment is of great interest to central-station managers.

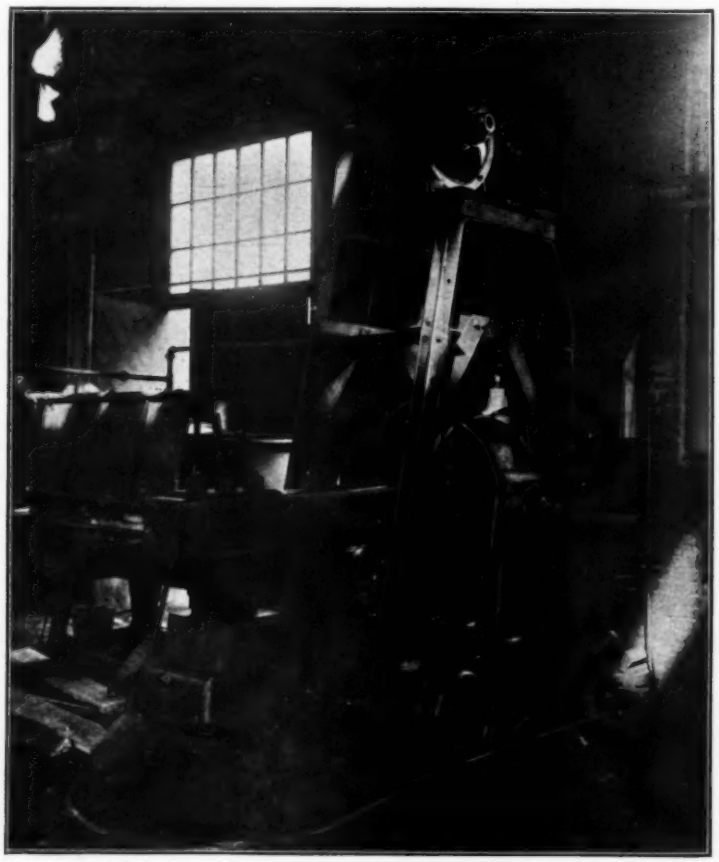
Replacing 66,000-Volt Chemical Fuse.

This particular installation is used to protect a three-phase substation taking current at 66,000 volts and transforming to lower commercial potentials. The illustration shows one phase of a three-phase service and also the method of handling the glass-tube fuses by means of insulated tongs. Five-ampere, 66,000-volt fuses have been blown under heavy short-circuit conditions on a feeder having behind it a generating capacity of 27,000 kilovolt-amperes. The short-circuit occurred close to the generators and the fuse successfully cleared the line in a fraction of a second.

This new protective device is manufactured by the Delta-Star Electric Company, Chicago, which is now conducting a series of investigations on all commercial potentials up to 110,000 volts. The cost of this circuit-interrupting device is much less than that of oil circuit-breakers or switches and this low investment cost is an important feature in selling current from high-tension transmission lines.

A Novel Overhead Motor Drive.

The illustration herewith shows the means by which a difficult change of drive, from countershaft to individual motor, was effected without alteration in the position of machine or the requirement of additional floor space. A prominent railroad shop recently changed over from the overhead countershaft form of drive to the use of individual motors for each tool. One of these, a helve hammer, necessitated a drive from above. It was not considered desirable to attach the motor to the side wall nor to suspend it from the ceiling, neither could the hammer be conveniently removed from its present position without seriously impairing the efficiency of the blacksmith shop. The following problem resulted: how to install a motor in position to give a downward drive through the idler fixed above the driven pulley without the use of countershafting or the erection of a wall-bracket platform. The solution was found to be as follows: a frame of angle irons was firmly bolted to the base of the hammer on either side; about two feet from the top of the hammer and ten feet from the floor a platform was laid across the angle-iron braces which admitted of the motor being placed over the tool out of the way, at the same time giving the drive desired. The shop is completely equipped with Diehl motors manufactured by the Diehl Manufacturing Company, of Elizabeth, N. J., a 650-revolution-per minute, 220-volt, direct-current motor being used in this particular instance.



Unique Motor Drive for Helve Hammer.

Thompson High-Voltage Series Cutout Hanger.

The developments in both metallic and carbon flame arcs during recent years have given a renewed impetus to series arc street lighting, which, with the increased height of lamp suspension, has called for improved facilities for trimming the lamps. Two important requirements must be met; one is to provide an absolute cutout to protect the trimmer against the high voltage that may be on the line and the other is to make the lamp accessible for trimming with the least amount of labor. Various means of meeting each of these needs have been devised and used with more or less success. Both of them have been met in an ingenious combination cutout and hanger recently placed on the market by the Thompson Electric Company, of Cleveland, O.

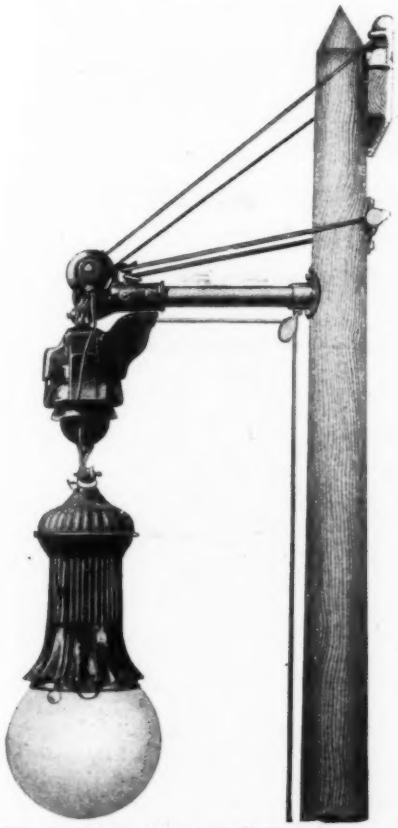


Fig. 1.—Cutout Hanger in Normal Operating Position.

The new device is suitable for any type of bracket or center-span suspension. Fig. 1 shows a simple pole bracket equipped with the hanger, the latter being in normal operating position. The hanger consists of two separable parts; the upper is fixed and contains a cord pulley and anchor for the fixed end of the cord, as well as the main part of the cutout mechanism and the terminals for the line circuit; the lower part can be lowered from its engagement with the upper and contains the lower pulley, the supporting and conducting catches and the terminals for the lamp circuit.

Fig. 2 shows the casing of the upper part of the hanger partly broken away so as to expose the mechanism, which is disclosed in its operating position. The catches, *C* and *D*, can be seen engaged by the ends of the contact bars *A* and *B*, which are connected to the line terminals and serve both to support the lamp and to conduct the current to it. Two phosphor-bronze springs increase the natural pressure between *A* and *B*. Between *C* and *D* is ample insulation since these catches connect with the lamp terminals.

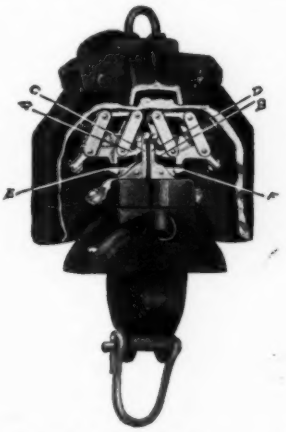


Fig. 2.—Partial Section of Hanger in Operating Position.

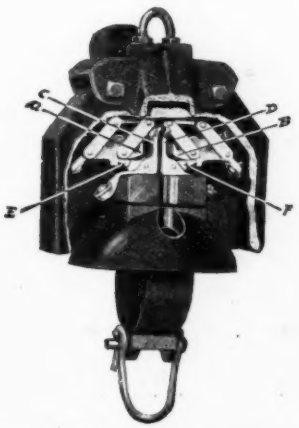


Fig. 3.—Section Showing Mechanism When Lamp is Ready for Lowering.

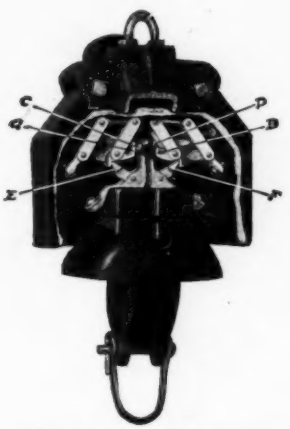


Fig. 4.—Mechanism When Lowering Has Begun.

When the lamp is to be lowered, the cord is first pulled a little, thus raising the lamp and the lower part of the hanger till the condition shown in Fig. 3 exists. The catches *C* and *D* have moved upward between the contact bars *A* and *B*, the latter being engaged by pawls *E* and *F* so as to separate them, thus releasing the catches and permitting them to be lowered through the opening between *A* and *B*. This is shown in Fig. 4. As soon as the catches have passed through, the bars *A* and *B* are pressed into wiping contact with each other, at the same time closing the line circuit and entirely separating the lamp therefrom. Fig. 5 shows the lamp being lowered, the two parts of the hanger being completely separated electrically and also mechanically, except for the rope.

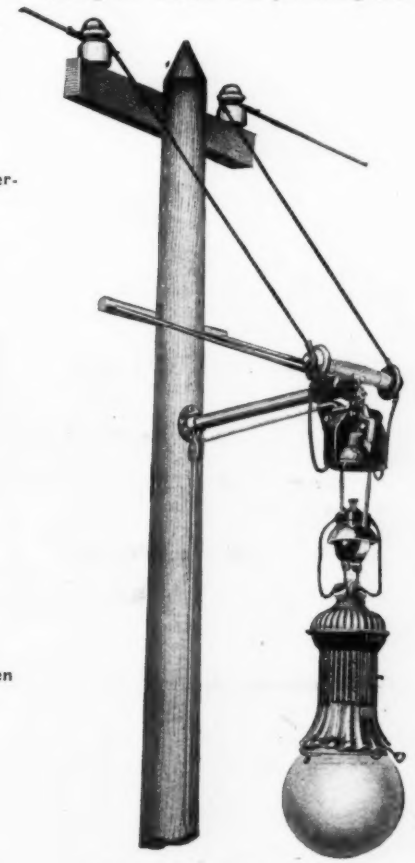


Fig. 5.—Lamp Being Lowered.

The foregoing brief description, together with the five illustrations, make self-evident what are the advantages of the new device. Foremost among these is the simplicity of the wiring that it permits; this is all on what may be termed

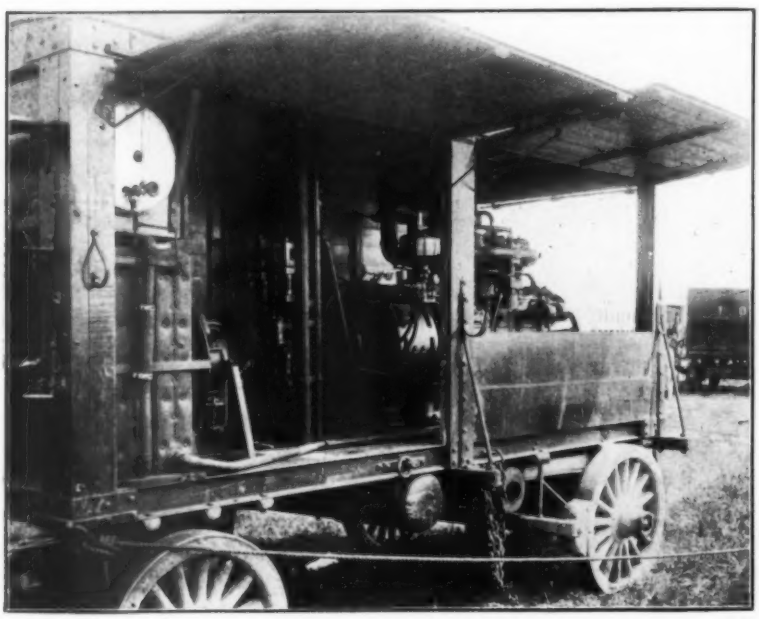
the straight-line plan, in which the unsightly, dangerous and expensive slack loops are entirely eliminated. Moreover, the trimmer is completely protected from the high-voltage line circuit because the lamp is entirely isolated therefrom before it can be lowered. The rope does not pass near to live parts. Two porcelain petticoats are provided to insulate the hanger. There is no strain on the rope except when the lamp is being trimmed. The cord and pulley arrangement is such that only half the weight of the lamp must be dealt with. Thus it is evident that the entire trimming operation is greatly facilitated and safeguarded, while at the same time the cost of the initial wiring is reduced and its appearance enhanced.

Portable Electric Lighting Outfit for Circus.

Electric lighting today has become almost universal in its application. There is scarcely a service in the entire illuminating field for which it is not being extensively employed. One of the latest provinces wherein electricity furnishes light at night is under the big canvases of the great modern circus, a veritable city that is always on the move and must therefore be completely self-contained and portable. Open-flame gasoline torches or gas lamps have lighted circuses for many years, but this season two of the largest tent shows in the world, the Barnum & Bailey and the Ringling Brothers circuses, are equipped with their own power plants for lighting the big top and smaller tents by electricity.

The apparatus consists of 25-kilowatt portable gasoline-electric sets, manufactured by the General Electric Company specially for the purpose. The units are carried in duplicate, two sets for each circus, so that if one should, by any chance, become disabled while en route, the other can supply current for at least half the lights. They are arranged, however, to operate regularly in multiple, each set furnishing current for 18 arc lamps, a total of 36 of these lamps being used for lighting a show. Two 25-ampere spot lights for the stage and several strings of incandescent lamps are also operated from the plants in each instance. A third supply wagon used for a workshop accompanies the outfits and has a powerful electric searchlight mounted on top, which is directed to different parts of the grounds while taking down tents and loading after the evening performance.

Two Generating Units and Supply Wagon Constituting Lighting Outfit.



Gasoline-Electric Generating Set for Circus Lighting.

The engines are built to run evenly and smoothly under all loads, for any sudden variation in speed, however slight, would immediately result in a flickering of the lights. They are accordingly designed to provide for close speed regulation with load variations, steady voltage at any load from zero to maximum load, a safe margin of capacity to assure continuity of service even though an overload condition arise, independence from storage-battery equipment, a minimum amount of attention, adequate protection from fire and explosions, exceptional durability of construction and thorough reliability of operation.

The outfits are very compactly built and are readily portable. They are mounted on one of the ordinary inclosed circus wagons, about 18 feet long and 7 feet wide, with the ends and sides of the truck body removable. Each unit is composed of a 25-kilowatt, 125-volt, compound-wound, direct-current generator, which is built integral with the frame and direct-connected to the shaft of a four-cylinder, four-stroke cycle, throttle-governed, vertical gasoline engine whose normal speed is 560 revolutions per minute.

The set is installed on the rear of the wagon with the flywheel at the outer end. The switchboard for controlling the current is located about two feet from the generator end of the unit. This is of the slate-panel type with main and feeder switches, instruments, rheostats, etc. At the front of the truck is installed the cooling system for the engine. It consists of a pressed-steel radiator having a 320-foot radiating surface, which is cooled by two motor-

driven fans. A 65-gallon, cylindrically shaped water tank is mounted directly over the radiator. The gasoline supply tank, holding 20 gallons, and the engine muffler are suspended underneath the wagon. The tents are all equipped with protected wiring that can be easily and quickly installed and removed each time the tents are erected and taken down.

Throughout mechanically and electrically these equipments are designed in accordance with the best engineering practice and constructed of the highest grade materials. The cylinders are cast separately and are firmly belted to a substantial one-piece base casting having doors to allow inspection of the cranks and bearings. The crank shaft is a treated-steel forging and turns in five bearings. The cam shaft is made of high-grade steel and is supported on the inside of the engine crank-case, the hardened cams being rigidly mounted on the cam shafts. The connecting rods are drop forgings and are fitted with removable babbitt-filled linings. The piston rings are made from the best close-grained gray iron, and are turned, ground and fitted with fine accuracy. The carburetor is of the constant-level type, to which gasoline is delivered by a pump integral with the engine.

Ignition is effected by a low-tension, automobile-type magneto and induction coil, with an auxiliary battery for starting. The governor is very sensitive and responds instantly to changes in load. It limits the speed variation of the engine from no load to full load within 4 per cent, which with the type of generator employed insures constant voltage. Adequate lubrication is secured by forced circulation from an oil pump.

The generator is one of the latest multipolar direct-current machines, designed especially to meet the characteristics of the engine to which it is connected. The field winding is compounded and compensates for the drop in engine speed between no load and full load, thereby maintaining a constant voltage throughout the entire range of operation. All similar parts of these outfits are built so that they are readily interchangeable insofar as is mechanically practicable, which allows replacing with renewals without tedious fitting.

Motor-Driven Hoist Used as a Scraper.

In order to remove the worthless soil above a valuable deposit of clay, the Twin City Brick Company, St. Paul, Minn., uses a drag bucket operated by a motor-driven hoist.

The clay deposit forms a bluff above the plant and the bucket is dragged over the surface, removing the soil on its down trip and returning empty. The bucket handles about 300 cubic feet of soil and makes a trip every two minutes. The hoist is a double-drum American machine and is driven by a 75-horsepower Westinghouse induction motor.

The use of electric drive is especially desirable for such an operation because it eliminates the hauling of fuel and water, enables one man to handle the entire machine, and involves no delays while steaming up. The hoist, being without a boiler, is also much easier to move from place to place.

Motor-Driven Hoist for Pulling Scraper.

Character of Ground Being Worked Over.

A New Apparatus for Cleaning Steam Boilers and Scaling Ships.

An entirely new and exceptionally interesting piece of apparatus for rapidly removing scale and rust from the interior of boilers and for scaling ship's plates, has just been placed on the market by the Electrical Engineering & Equipment Company, Limited, of New Oxford street, London, W. C., England.

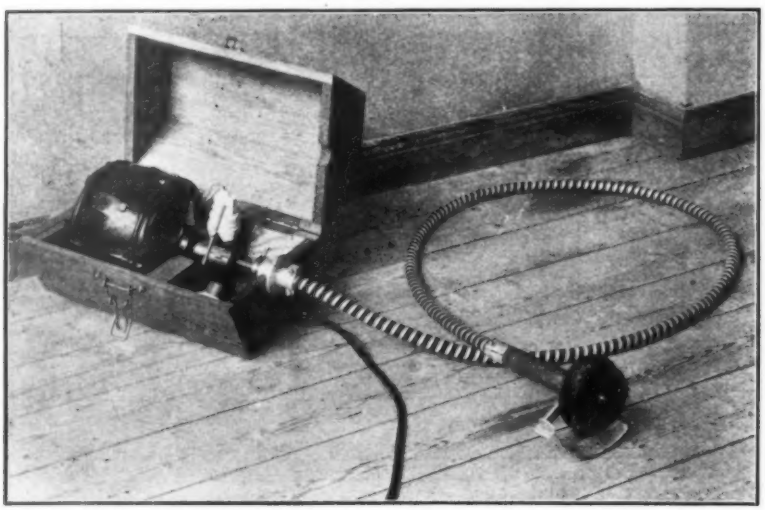
The rapid and efficient removal of boiler scale has always proved a particularly annoying problem to steam engineers and for many years past the latter have sought in vain for a satisfactory solution of the difficulty. Many forms of apparatus, constructed on various principles, have been put forward from time to time, but in every case these have proved unsatisfactory in practice, so that at the present day the older methods, viz., the use of the chipping hammer, scraper and in some cases the pneumatic hammer are still almost exclusively employed. Even the attempt to avoid the formation of scale by the chemical treatment of the water has proved, on the whole, far from satisfactory. In the first place, the plant for this purpose requires very careful attention and is very expensive both in initial cost and in the cost of upkeep; secondly, it has certain distinct disadvantages; and finally, when all is said and done, it does not always nor completely prevent the formation of scale, so that cleaning of the boilers from time to time becomes necessary in any case. Every steam engineer who has carefully studied the practical working of his plant will be aware of the truth of these statements.

Now the chipping hammer, scraper and pneumatic hammer can only be used satisfactorily when the scale is at least one-eighth inch thick, and it is just the hard thin layer of deposit and rust which present the greatest difficulties in removal.

The new apparatus made by the Electrical Engineering & Equipment Company is capable of dealing with layers of any thickness and of any nature, and operates at a speed quite unattainable by hand and pneumatic tools, whilst at the same time it leaves the surface of the boiler much cleaner than is the case when the older methods are employed.

The apparatus consists of an electric motor mounted in a special box and connected by means of a flexible shaft to an ingenious device consisting of a flat metal drum provided at three points in its periphery with steel wheels loosely centered on pins. When the drum is caused to rotate by

starting the motor, the steel wheels, which are similar to milling cutters, fly outward by centrifugal force, and exert a continuous hammering action upon any surface against which they are pressed. At the same time, owing to the formation of the wheels, a tearing action is exerted simultaneously with the hammering. The motor makes 2,600 revolutions per minute, so that it is possible to obtain $2,600 \times 3 = 7,800$ hammer blows per minute. These figures alone suffice to give an idea of the vastly quicker rate of working which is attainable with this apparatus as compared to any of the hand or pneumatic tools. The steel hammering wheels, being loosely mounted on pins, can retreat inward after each blow, and can also rotate about their axes, in consequence of which vibration is avoided, and the sharp edges of the wheels are protected against unnecessary wear. The centrifugal force exerts at the same time a natural spring action which takes up the shock of the hammer blows, so that the apparatus is entirely free from vibration.



Motor-Driven Boiler and Ship Scale Remover.

The box containing the electric motor is made of such size and shape that it can be easily lowered through the manhole of any boiler (for which purpose it is also provided with suitable handles, both in the top and on the ends). There is furnished a small chain connected to the motor switch and passing through the end of the box, so that the apparatus can be started and stopped by the workman by simply pulling the chain.

The flexible coupling is so adapted that the core can be easily removed in its entirety from its protecting tube, enabling it to be lubricated in the simplest manner with a mixture of graphite and oil. In this way the lubrication difficulties so common to flexible shafting are entirely avoided.

The drums are made in five different diameters, viz., from 2.75 inches up to 5.25 inches, and the hammer wheels and the drum are also varied, so that the strength of the hammer blows can be altered according to the thickness and nature of the surface which is being cleaned. In this way the apparatus can be adapted to the greatest variety of cases.

The most striking feature of the whole apparatus is its extreme simplicity. It does not contain a single complicated part which would be liable to get out of order, and it can be used by any workman practically without any previous instruction.

The apparatus is used in precisely the same way for scaling ships as for cleaning boilers, and has shown marked advantage over any other methods heretofore employed.

As regards the rate of working with the apparatus, it has been shown by experiment in work docks, etc., that on the average it works three to four times faster than the best hand apparatus manipulated by the most practiced workman, while in the case of very thin deposits it has even attained a speed of as much as 40 times that of the hand tools.

Demonstrations already have been given at some of the largest works and shipping docks. At a demonstration which took place on the skin of a Russian volunteer ship undergoing repair, in the presence of representatives of various firms an interesting practical test was made on the speed of working with the apparatus, as compared to the pneumatic hammer. A practiced workman was set to clean a certain measured area of the ship's side, and the time occupied was taken. The new electrical apparatus was then used to clean an equal measured area, and the time was again noted. The results showed that the apparatus worked some fifty per cent faster than the best pneumatic hammer.

In conclusion, it may be mentioned that the apparatus is supplied at a very low figure, and that all replacement parts are not only inexpensive, but can also be attached rapidly and with the minimum trouble by even inexperienced workmen.

Hydroelectric Plant for Electric Smelting in New Caledonia.

An important hydroelectric plant being erected by a French company in the south of the island of New Caledonia, in the Pacific Ocean, for the production of ferronickel and ferrochrome involves the construction of two generating stations at different levels on the Yate River. For the lower station, which is being built first, the water will be diverted from the river by a dam 13 feet high to a tunnel 9,500 feet long, which will deliver 34,000 cubic feet per minute, with a head of 350 feet, to the turbines. Electric smelting works will be erected in close proximity to the generating station. A similar quantity of water, with a head of 157 feet, is available for the higher plant, which will generate 7,600 horsepower to be converted to high-tension current for transmission to various points.

Park Lighting in Louisville.

Work has been started by the Louisville (Ky.) Gas & Electric Company on the new lighting system for Louisville public parks and boulevards, a contract with the Board of Park Commissioners having been signed for the erection and maintenance of the lighting standards, which are of an ornamental design. A single globe surmounts each standard. The latter is well designed and makes a good appearance, but the general effect is somewhat detracted from by the wire connections, which are necessarily made overhead. The result is much less desirabe than when underground wires are used as in the down-town districts, but this does not appear to be feasible for park work.

Record Performance for Electric Truck.

A remarkable performance is recorded for a five-ton General Vehicle truck owned by the Manhattan Brewing Company, Chicago. This truck fully loaded made three trips on Monday August 4, between the brewery and South Chicago, aggregating 64.3 miles on a single charge and in less than 10 hours, including all stops. One trip was made in approximately two and one-half hours. The average speed was nine miles per hour, and the average amperes drawn, 10.1.

Current Electrical News

LIGHTING AND POWER.

(Special Correspondence.)

ALBIA, IOWA.—City council is considering putting in an electric light plant. C.

BAYARD, IOWA.—$6,000 bonds have been voted to install an electric light plant. C.

DE KALB, ILL.—The De Kalb Electric Company plans to install ornamental lighting.

SWEA CITY, Ia.—The construction of a municipal electric light plant is being agitated here.

ST. PAUL, KANS.—The Council will install electric lighting. Address the City Clerk for particulars.

BRITT, IOWA.—Britt Electric Light & Plant Company is building a large brick addition to its plant. C.

LAWLER, IOWA.—Almost unanimously this place voted $6,000 in bonds to build an electric light plant.

LA GRANGE, KY.—The La Grange Light & Power Company is planning to construct a street lighting system.

ALEDO, ILL.—The County Commissioners will re-wire courthouse. Address the County Auditor for information.

FONTANELLE, IOWA.—Fontanelle is to get electric light and water plant; Greenfield may furnish the power. C.

AURORA, MINN.—The Council is considering the installation of additional equipment for electric light plant. C.

STERLING, ILL.—An electric elevator may be installed in the new city hospital. The cost would be about $2,000.

NEOSHO FALLS, KANS.—An electric plant will be installed here. Address the City Clerk for desired information.

BUHL, MINN.—Bids are wanted on equipment for village electric light plant, changing same from direct current to alternating current. C.

TRENTON, N. J.—Ogden D. Wilkinson, 2031 Walnut Street, is at the head of a syndicate which will erect a light and power plant here.

PLEASANTON, TEX.—It has been definitely decided that Pleasanton will have street lights. Address the Mayor in regard to the matter.

BENTON HARBOR, MICH.—The Benton Harbor Club plans to light 12 blocks with boulevard lighting. Address the secretary for particulars.

LINCOLN, ILL.—Business men on Broadway, between Kickapoo and Chicago Streets, have started a movement to secure ornamental lights. Z.

POCAHONTAS, IOWA.—Pocahontas may receive electric power from a line being extended to Fonda and Pomeroy by the Northern Iowa Power Company.

SPIRIT LAKE, IOWA.—James H. Ehert will rebuild the electric light and power plant at once; estimated cost, $15,000. Fire recently destroyed the old plant. C.

WATSEKA, ILL.—The Central Illinois Utilities Company has purchased site here for the construction of a new power plant. H. J. Frith is general manager.

MOLINE, ILL.—The city commission may replace the arc lamps now used for street lighting with tungsten lamps. Thirteen lamps have been placed for experimental purposes.

CYNTHIANA, KY.—The Cynthiana Electric Light Company is improving its plant. An order for a new engine was recently placed and additional betterments are contemplated. G.

PALOUSE, WASH.—The Washington Water Power Company of Spokane contemplates making several important transmission-line extensions running out of this city. O.

RED OAK, IOWA.—Special meeting will be held to consider granting franchise to Red Oak Electric Company for electric lines to be built over the public highways in this vicinity. C.

OAK HARBOR, O.—The City Council has passed a resolution to submit the proposition of bonding the town for a municipal lighting plant. Address the City Clerk for particulars.

CLATCKANIE, ORE.—W. W. Seymour, president of the company which has purchased the local electric light plant, announces that extensive improvements are under way.

MONTEZUMA, IA.—The franchise of the new electric company carried by a very large vote. The McKinley System expects to spend about $40,000 improving lights. Address city clerk.

LOS ANGELES, CAL.—Plans for the installation of street lights in the Gardena district of the city by the California Edison Company have been approved by the board of public works.

SEATTLE, WASH.—The Puget Sound Traction, Light & Power Company has been granted a franchise for stringing wires along the county roads to Kirkland, Redland and in certain portions of north Seattle.

PLATTSMOUTH, NEB.—The Nebraska Lighting Company has concluded to entirely rebuild its plant here. Arthur Huntington, of Chicago, is the engineer in charge of the work and has located in Plattsmouth for the present.

EDEN VALLEY, MINN.—Central Minnesota Light & Power Company purchased the property and interests of the Lethert Light & Power Company and will operate same; they also obtained franchises for Watkins and Kimball. C.

DOVER, DEL.—The charter of the Ingison Hydro-Electric Power Company, of Bowbells, N. D., was filed here recently. The company has a capital of $1,000,000, with Charles Becker of Bowbells, N. D., as the principal incorporator.

ST. JOHN, N. B.—A municipal power plant on the site of the old Mispec pulp mill is said to be the ambition of Commissioner Wigmore, who believes there is sufficient water at this point to develop current enough to supply this city.

CAMDEN, N. J.—The Camden Council will give a public hearing upon the pending ordinance providing for the installation of the proposed municipal electric light plant which the people voted for by a large majority seven years ago.

MADISONVILLE, TEXAS.—The Madisonville Light and Power Company has been organized here for the purpose of constructing an electric light and power plant. A. A. Allen, A. E. Page and F. E. White are the incorporators. D.

INDIANAPOLIS, IND.—The Merchants Heat & Light Company will improve its plant to the extent of $100,000. Among other improvements the company will install one of the largest turbine engines in the state, at an approximate cost of $10,000.

NEW ROCKFORD, N. D.—Petitions are being signed by practically all the business men for the "White Way" system of street lighting for this city. The system will cover the principal streets of the city and be one of the finest in the state when completed.

OSAGE, IOWA.—Plans for a new power house with full equipment for the manufacture of electric light and power have been drawn by Feris Brothers, of this place. The site of the proposed plant is two miles south of the city on the Cedar River. The cost is estimated at $20,000.

VAN HORN, TEXAS.—The commissioners' court of Culberson county has purchased the electric light and power plant and water works system of the Van Horn Light and Water Company and will enlarge the properties and make other improvements to the service. D.

SPOKANE, WASH.—The special committee appointed by the city council to inquire into the possibility of the acquisition of a power site on the Spokane River for a municipal lighting plant held its first meeting a few days ago. It is estimated that the project will cost over $1,000,000.

NIAGARA FALLS, N. Y.—Canadian-American Power Corporation has been incorporated with a capitalization of $4,000,000 for the purpose of generating and distributing electricity. The incorporators are E. G. Connette, Buffalo, N. Y.; S. Reading Bertron and Marshall J. Dodge, of New York City.

PARKERSBURG, W. VA.—It is reported that work has started on the new 12-kiln electric porcelain plant to be built here by the General Electric Company, the cost of which is said to be about $50,000. The plan is to be so constructed as to be added to later and it is the intention to double the capacity eventually.

DOLAND, S. D.—Articles of incor-

poration have been filed for the Doland Electric Company to furnish power and lights to the people of this town. The company is capitalized at $10,000 and is a local organization, the incorporators being D. P. Fargo, William Wells, A. J. Ricks, W. J. McCormick, R. W. Labrie and J. B. Conley, all of Doland and vicinity.

PORTLAND, ORE.—The Laurelhurst Improvement Club recently petitioned Mayor Albee and the City Commissioners to purchase the lighting system now in use in Laurelhurst. Matter has been referred to a committee who will investigate the feasibility of the proposition. If the proposed plant is taken over, much improvement work will be necessary. O.

PANA, ILL.—The Central Illinois Public Service Company of Mattoon has made a proposition to the City Council to furnish power for street lighting at $60 per arc per year and to sell power for domestic purposes at 8 cents per kilowatt-hour, power for big consumers at 4 cents per kilowatt-hour and power for ornamental street lighting at 4 cents per kilowatt-hour, the top light to be lighted free after 11 p. m.

SAN FRANCISCO, CAL.—In the hearing given the Oro Electric Corporation by the Railroad Commission the original application for bond issues of $1,000,000 to complete the Yellow Creek power projects and of $686,000 to cover an issue already disposed of, was reduced by the corporation to a single issue of $200,000. This amount will take care of the immediate needs of the company and the larger amounts will be applied for later.

SACRAMENTO, CAL.—The Railway Commission of this state has granted the right to the Pacific Gas & Electric Company to expend $2,400,000 in additional developments of the company's Bear River hydroelectric projects. These further developments include the purchase of ditches and water rights from the United Water & Power Company, the construction of additional power plants and the construction of a transmission line from Nicolaus to this city. T.

DULUTH, MINN.—The St. Louis Power Company has filed articles of incorporation with the secretary of state of Minnesota. The corporation is capitalized at $1,000,000. It is organized for the purpose of generating electricity by steam or water power for public use, and the distribution of light, heat, and power within the state. The company's headquarters are at Duluth. Incorporators are: J. B. Crane, A. G. Gillette, J. A. Sinclair and Harry A. Carmichael, all of Duluth. C.

GLENDALE, CAL.—Manager Harry Lynch of the municipal lighting department of this city and an employee of the contracting department of the Pacific Light & Power Company, will have charge of the installation of the new power plant at Burbank, about four miles north of this place. That city lately voted bonds to the extent of $20,000 for lighting purposes and have secured the money and work will be started at an early date and rushed to completion. Mr. Lynch also has the work in charge on the 180 new lamps to be installed at Casa Verdugo. This work will be strictly modern, as all wires will be run underground and the lamps will hang from iron standards. T.

TELEPHONE AND TELEGRAPH.

(Special Correspondence.)

GLENDALE, CAL.—The Pacific Telephone & Telegraph Company has been granted a franchise in this city.

MONTICELLO, IOWA.—The Bell Telephone Company will rebuild its telephone system in this city at a cost of $25,000.

RIVERSIDE, CAL.—Bids will be received up to August 20 for a telephone and telegraph franchise on certain streets in this city.

TUSCOLA, MICH.—Tuscola Farmers Telephone Company has been incorporated with a capitalization of $10,000 to operate a telephone system.

SARATOGA, CAL.—The Pacific Telephone & Telegraph Company has been granted permission to purchase the Saratoga Telephone Company for $3,000.

SCRANTON, PA.—An appropriation of $10,000 has been made to place fire and police wires underground. Address the City Electrician in regard to the matter.

SPECK, KY.—Speck & Knifley Telephone Company has been incorporated with a capital stock of $1,000 by J. V. Robinson, William Warren, William Young and J. W. Mings.

JAMESTOWN, N. D.—At a special meeting of the City Council the ordinance requiring all telephone wires placed underground was passed. Address the City Clerk in regard to the matter.

BISBEE, ARIZ.—The Mountain States Telephone & Telegraph Company will install a second wire between Bisbee and El Paso which will serve all southern Arizona points.

YUBA CITY, CAL.—The Colusa Telephone Company has applied for a franchise to extend its line into Sutter county. The franchise will be sold to the highest bidder on September 15.

LOS ANGELES, CAL.—Articles of incorporation have been filed here for the Hanson Wireless Telephone & Telegraph Company with a capital stock of $25,000, by C. L. Hanson, H. La V. Twiniax and L. Fall.

LONG LAKE, N. Y.—Long Lake Telephone Company, Incorporated, has been granted articles of incorporation with a capital stock of $10,000. The incorporators are Timothy D. Sullivan, Bridget A. Sullivan and John M. Sullivan, all of Long Lake.

ALEXANDRIA, S. D.—The Wayne & Rosedale Rural Telephone Company has been organized here to construct a toll line out of Alexandria into several adjoining townships. The capital stock is $1,000 and the incorporators are J. B. Harding, Jacob Shields, Peter Arend and Jean Kayser.

BELGRADE, MONT.—The Dry Creek Telephone Company recently filed articles of incorporation with a capital stock of $2,100. The Company will construct three telephone lines running north, northwest and northeast from this city. The directors are Wesley Davis, W. L. Brownell and James M. Moore. O.

BERTHA, MINN.—The Aldrich Telephone Company has filed articles of incorporation and will build and operate rural lines. The incorporators are Hiram Kilburn, Rudolph Haase, Albert Lind, all of Stowe Prairie, Minn.; W. E. Partlow, Charles J. Leave, both of Bartlett, Minn. The capital stock is $1,000.

ELECTRIC RAILWAYS.

(Special Correspondence.)

LOUISVILLE, KY.—The Louisville Railway Company is considering the extension of its Brook Street line from Oak to Hill Street. T. J. Minary is president. G.

RIVERSIDE, CAL.—It is understood that the Pacific Electric Railway Company intends making material improvements and extensions on its system of lines at this place. T.

PORTLAND, ORE.—The projected improvements planned by the Portland Railway Light & Power Company at a cost of $100,000, at the foot of Washington Street will not be made this year, according to present plans. O.

EVANSTON, ILL.—The Evanston Traction Company has been incorporated with a capital stock of $10,000 to operate and own street railways. The incorporators are Frank M. McCulloch, Bertram W. Rosenstone and Claude O. Netherton.

SEATTLE, WASH.—The Board of Public Works will receive bids until August 21 for trolley wires for the Seattle Municipal Railway, as per a recent ordinance. For further information, address A. L. Valentine, chairman of the above board. O.

OLYMPIA, WASH.—Millard Lemon, W. B. Foshay, et al, here, recently filed articles of incorporation for the Washington Public Service Company, of this city. Company is capitalized at $1,500,000, and purposes construction of electric railway, etc. O.

SAN RAFAEL, CAL.—S. J. Norton, of this city, is promoting a new electric railroad to join San Rafael, San Anselmo and Fairfax. It is to be named the San Rafael-San Anselmo Valley Railway Company. It will be six miles long and will cost approximately $100,000.

HAMILTON, ONT.—It is announced that the Canadian Pacific Railway Company will immediately commence work on an electric line between Hamilton and Niagara Falls. This will enable the company to handle traffic direct from Hamilton to Buffalo on its own right of way.

LOS ANGELES, CAL.—A cross-town line in the eastern section of this city is practically assured. A petition has been presented to the city clerk and signed by 900 property owners living in the region of Brooklyn Avenue and Eastlake Park, asking the City Council to advertise for sale a franchise for the double-track electric railway. T.

LOS ANGELES, CAL.—It is understood that Railroad Commissioners Eshleman and Edgerton, of San Francisco, have been making certain investigations with a view to requiring the Pacific Electric Railroad Company to install a block system over its entire length. This would necessitate an expenditure of approximately $1,500,000.

CHEPACHET, R. I.—It is understood that contracts have been signed by President Charles S. Mellen, for the Rhode Island Line, and the members of the Town Councils of Centredale and Chepacet by which the Rhode Island Company guarantees to build and complete within one year an electric passenger and freight line between the two towns.

LEBANON, PA.—Surveyors are now at work on a proposed trolley line to connect Elizabethtown and Hershey. Two companies have been organized and chartered for the purpose of building the road. They are the Elizabethtown

& Deodate Railway Company and the Deodate & Hershey Railroad Company. The new line will be eleven miles in length.

VANCOUVER, WASH.—The Olympia & Southern Railway Company, affiliated, it is claimed, with the Chicago, Milwaukee & St. Paul system, recently obtained franchises to operate in Thurston and Lewis County, and have applied for a franchise in Cowlitz County. The Company has also secured options on land for their shops in this city. The road will be electrified upon completion. O.

SPOKANE, WASH.—J. P. Graves, Clyde M. Graves and A. L. White recently made an offer to the Spokane & Inland Electric Railway Company whereby they will pay $5,000, secure an additional $5,000, and get a right of way from the city limits to Waikiki Farm, for a street railway system. Joseph H. Young, of this city, is president of the Spokane & Inland, and desired information can be derived from him. O.

HARLOWTOWN, MONT. — Advices have been received that the Chicago, Milwaukee & Puget Sound Railroad Company is to electrify 450 miles of its main line between Harlowtown and Avery, Idaho. The Great Falls Power Company which will furnish the electric power, has been given a 50-year grant by the Department of the Interior to transmit current over public domain under strict government regulations.

OLYMPIA, KY.—The Olympian Springs, (Ky.), Railway, Power & Light Company has been incorporated with J. D. Wilson, Greensburg, Ky., president, and S. F. Crecilius, Louisville, Ky., engineer. Its chief object is the construction of an electric railway between the springs, where a hotel is located, and Olympia, a station on the Chesapeake & Ohio railroad, a distance of four miles. G.

HOPLAND, CAL.—After having completed its surveys and acquired almost all of the rights of way for its proposed extension of its line from this city to Lakeport, a distance of 25 miles, the Clear Lake Railway Company has applied to the State Railway Commission for the privilege of issuing bonds to the extent of $396,300, for the purpose of building this proposed road. The application states that $87,000 has already been expended. T.

LOS ANGELES, CAL.—Substitution of electricity for steam power and a cheap and frequent car service to Pacific Beach and La Jolla and intermediate points are promised by the officials of the Los Angeles & San Diego Beach Railway, known as the La Jolla line, if the Council grants the franchises asked for by President E. S. Babcock, of the railway. Double tracking of the company's tracks on the Fourth and Sixth Street loops, as well as the application for a franchise for an electric line to run from Fourth and C Streets to the Panama-California Exposition, are contemplated.

SEATTLE, WASH.—Public Utilities Committee of the City Council recently voted that an offer of $1,250,000 be made for the entire property of the Seattle, Renton & Southern Street Railway on the terms proposed by Scott Calhoun, receiver of the company. The property includes a double-track line, extending from Third Avenue and Stewart Street on the North, to the City of Renton on the South, a distance of nine miles, about one-half lying in the city limits, the other half in King County. A majority of the members of the City Council also favor the purchase, and it is an assured fact that the line will be taken over by the City, and many improvements made, the line first being converted into a municipal street railway. O.

MOUNTAIN HOME, ARK.—Letters have been received by the local banker here from a Chicago Company, which proposes to build an extension of the Mansfield-Ava road in Douglass County, Mo., to connect with the White River road at a point near Cotter, stating that engineers are ready to take the field. From the general tone of the letters received, the proposed line is to be an electric line and the power with which it will be operated will be generated from some local stream, probably the North Fork. A request was also made for a light and water franchise and all the encouragement possible was given. The road, if constructed, will run through some of the best land in the Missouri and Arkansas Ozarks, and will form a connecting link between the Frisco and the Iron Mountain.

PROPOSALS.

SWITCHBOARDS, ETC.—Sealed proposals will be received at the Engineer Depot, United States Army, Washington Barracks, D. C., until August 22 for furnishing five direct-current switchboards, etc. Further information upon application to W. J. Barden, Major, Corps of Engineers, U. S. Army.

MOTOR - DRIVEN MACHINE TOOLS.—Sealed proposals will be received by the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., until September 2 for furnishing a large number of miscellaneous motor-driven machine tools, for delivery at the Navy Yard, Mare Island, Cal.

LIGHTING, WIRING AND HEATING.—Sealed proposals will be received at the office of the Supervising Architect, Washington, D. C., until August 20 for additional conduit and wiring, lighting fixtures, etc., in the first story of the court house at Rochester, N. Y., in accordance with drawings and specifications, copies of which may be obtained from the custodian of the office of the Supervising Architect.

LIGHTING FIXTURES AND ELECTRIC PROTECTION. — Sealed proposals will be received at the office of the Supervising Architect, Washington, D. C., until September 2 for the interior lighting fixtures and electric protection of two interior money vaults in the subtreasury at San Francisco, Cal. Drawings and specifications may be obtained from the Superintendent of Construction, San Francisco, or from the office of the Supervising Architect.

ELECTRICAL EQUIPMENT.—Sealed bids will be received by the City of Alma, Neb., until August 12 for furnishing one 80-horsepower fuel-oil engine; one 75-horsepower Corliss steam engine; two 100-horsepower boilers; two feed-water pumps; one feed-water heater and one 80-foot-by-36inch iron stack and breech. Plans and specifications may be obtained by applying to the City Clerk or to C. O. Lund, superintending engineer, Norton, Kans.

CABLE.—Sealed proposals will be received at the office of the Chief Signal Officer, War Department, Washington, D. C., until August 11 for furnishing 1,200 feet power rubber-insulated cable, 1,500 feet one-conductor insulated cable, 1,300 feet four-conductor rubber-insulated cable, and 1,000 feet ten-conductor rubber-insulated cable under Proposal No. 665. For further information address W. L. Clark, Major, Signal Corps, U. S. A., disbursing officer.

ELECTRIC CONDUIT AND WIRING AND INTERIOR LIGHTING FIXTURES.—Sealed proposals will be received at the office of the Supervising Architect, Washington, D. C., until September 3 for the electric conduit and wiring and interior lighting fixtures for the post office at Gettysburg, Pa., until September 8 of a one-story building for the post office at Gettysburg, Pa.; until until September 11 of a two-story building for the post office at Pasadena, Cal., in accordance with drawings and specifications, copies of which may be obtained from the custodians of the sites and from the office of the Supervising Architect. Washington, D. C.

ELECTRICAL FITTINGS.—Sealed proposals will be received by the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., until August 19 for furnishing the following electrical fittings:

Article.	Quantity.	Delivered at Navy Yard.	School.
Battery, truck and storage, complete, etc	Miscellaneous	Philadelphia, Pa	5709
Cable, telephone, paper insulated, lead sheathed	500 feet	Brooklyn, N. Y	5701
Cable, duplex, rubber insulated, lead sheathed	3,500 feet	Brooklyn, N. Y	5701
Cable, 3-conductor, paper insulated, lead sheathed	700 feet	Brooklyn, N. Y	5701
Fixtures, electric	Miscellaneous	East and west	5659
Galvanometer, high sensitivity, etc.	1	Mare Island, Cal	5665
Globes for electric fixtures	Miscellaneous	East and west	5659
Reflectors, prismatic	Miscellaneous	East and west	5659
Sets, turbo generator, 50 K. W., complete	2	Mare Island, Cal	5664
Sets, turbo generator, 100 K. W., complete with spare parts	2	Mare Island, Cal	5664
Transformers, current, portable	3	Mare Island, Cal	5665
Wattmeters, indicating, double voltage, single phase	3	Mare Island, Cal	5665
Grinder, disc, spiral, motor-driven, complete	1	Norfolk, Va	5711
Restranding and insulating cables		Boston, Mass	5701
And until August 26 for:			
Cable, electrical, miscellaneous, paper insulated and lead sheathed	9,600 feet	Mare Island, Cal	5712
Conduit, vitrified clay, sewer pipe and traps	Miscellaneous	Mare Island, Cal	5680
Furnishing and installing of direct current oil engine-driven exciter unit		Naval Engineering Experiment Station, Annapolis, Md.	5679
Furniture, metal	Miscellaneous	Brooklyn, N. Y., etc	5699
Generator, alternating current	1	Naval Engineering Experiment Station, Annapolis, Md	5679

FINANCIAL NOTES.

The New York Stock Exchange has admitted to the list, $12,541,000 first and refunding five per cent bonds of the Interborough Rapid Transit Company and has given permission to list $148,416,000 additional of these bonds prior to July 1, 1914, on official notice that they have been sold and have passed beyond control of the company.

The New York Edison Company has made application to the New York Public Service Commission for authority to issue $15,800,000 additional capital stock with which to refund at par notes issued for cash and invested plant and property. The notes are held by the Consolidated Gas Company of New York. The present authorized capital of the New York Edison Company is $50,549,400, of which $50,153,400 is issued and outstanding.

The special meeting of the Blackstone Valley Gas & Electric Company of Pawtucket and Woonsocket, R. I., called for August 12, is to authorize the increase of the capital stock of the company by the issue of $250,000 preferred and $250,000 common stock additional, making the capitalization of the company consist of $1,350,000 preferred and $2,250,000 common stock. The increase is for the purpose of providing additional funds for additions and improvements.

The Ohio Public Service Commission has granted the application of the Springfield Railways Company to issue $1,244,000 six per cent first mortgage bonds, and $356,000 preferred stock, to reimburse the company for improvements made, and to provide additional extensions and equipment. The company is one of the subsidiary properties of the American Railways Company, and the latter will take the new securities and provide funds for the Springfield company. The latter recently secured a new twenty-five year franchise, and the financing is in connection with improvements and additions to be made under the new grant.

At a meeting of the Northern Colorado Power Company held in Denver, A. W. Chambers, vice-president of the Electric Properties Company, and William Scott Lee, chairman of the stockholders' protective committee, arranged the final details in regard to the reorganization of the company, signing all the contracts in connection with the reorganization. The outstanding bonds are reduced from $2,693,000 to $2,000,000, according to the new plan, which was approved by 90 per cent of the first mortgage bondholders. The $853,400 of notes on which the default of interest almost caused a receivership are also cared for. For outstanding common and preferred stocks one share of new stock will be issued for each four shares now held. The new bonds will begin to draw interest November 15, 1913, and the new preferred stock will become cumulative on January 1, 1913.

Dividends.

Boston Elevated Railway Company; the regular semiannual dividend of three per cent, payable August 15 to stock of record August 2.

Cleveland & Buffalo Transit Company; regular quarterly of 1.25 per cent and an extra of 1.5 per cent.

Tonda, Johnstown & Gloversville Railroad; a common dividend of two per cent, payable August 15 to stock of record August 5.

Middle West Utilities Company; quarterly dividend of $1.50 on the preferred stock, payable September 2, to stock of record August 15.

Mobile Electric; regular quarterly dividend of 1.75 per cent on the preferred stock is payable August 15, to stock of record July 30.

Pacific Gas and Electric Company; regular quarterly of $1.50 a share on its preferred stock, payable August 15 to stock of record July 31.

Portland Railway, Light & Power Company; a regular quarterly dividend of 1.25 per cent, payable September 2 to stock of record August 12.

Tampa Electric Company; a quarterly dividend of $2.50 per share, payable August 15 to stock of record August 6.

Underground Electric Railways Company, of London, Limited; semiannual interest payment of three per cent on the income bonds, payable September 1.

United States Telephone Company; a quarterly preferred dividend of 1.5 per cent, payable August 15 to stock of record July 31.

Reports of Earnings

MOUNTAIN STATES TELEGRAPH COMPANY.

The income statement of the Mountain States Telegraph & Telephone Company for the two months ended May 31 shows net earnings of $452,514, an increase of $64,055 over the previous two-months period. Following are the company's earnings for the two months ended May 31, compared with the previous period:

	Two mos. ended. May 31, '13.	Increase.
Gross earnings	$1,226,441	$57,807
Operating expenses	773,927	*6,248
Net earnings	$452,514	$64,055
Dividends established, two months	346,328	31,397
Reserves and surplus.	$106,186	$32,658

*Decrease.

TWIN CITY RAPID TRANSIT.

	1913.	1912.
June gross	$ 754,495	$ 692,417
Net	391,253	356,564
Surplus after charges and prev. dividends.	245,810	213,485
Six months gross	4,230,531	3,926,120
Net	2,064,306	1,877,514
Surplus after charges and pfd. dividends..	1,185,677	1,022,039

NORTHERN OHIO TRACTION & LIGHT.

	1913.	1912.
June gross	$ 291,518	$ 276,960
Net	113,163	122,472
Surplus after charges.	54,557	78,655
Six months gross	1,497,237	1,377,335
Net	568,779	584,505
Surplus after charges.	225,673	321,580
Total business	.....	9,392,000

AMERICAN TRACTION COMPANY.

The report of the American Light & Traction Company for the year ended June 30, 1913, shows net earnings of $4,240,721, against $3,993,684 in 1912. This is at the rate of 25.6 per cent on the common stock, after allowing for 6 per cent on the preferred. The income account compares as follows:

	1913.	1912.
Earn. on stock sub. cos.	$3,781,422	$3,567,241
Miscellaneous earnings.	579,130	545,719
Total earnings	4,360,553	4,112,959
Expenses	119,831	119,276
Net earnings	4,240,721	3,993,684
Prev. surp. and reserve.	8,140,612	7,315,670
Total surplus	12,381,333	11,309,354
Cash dividend, pref.	854,172	854,172
Cash dividend, common	1,277,007	1,157,285
Stock dividend, common	1,277,007	1,157,285
Total dividend	3,408,187	3,168,742
Surplus and reserve, June 30	8,973,146	8,140,612

NEW ORLEANS RAILWAY & LIGHT.

The report of the New Orleans Railway & Light Company for the six months ended June 30, 1913, compares as follows:

	1913.	1912.
Gross earnings	$3,467,585	$3,342,493
Expenses, taxes, etc.	2,139,812	1,988,356
Net earnings	1,327,773	1,354,137
Miscellaneous deductions	72,201	34,409
Balance	1,255,571	3,319,727
Interest	787,146	788,271
Surplus	468,425	531,455

REPUBLIC RAILWAY.

The Republic Railway & Light Company reports earnings for June, 1913, and the twelve months ended June 30, 1913, as follows:

	1913.	Increase.
June gross	$ 248,668	$ 33,932
Net after taxes	96,640	11,080
Surplus after charges	54,648	13,031
Twelve months gross	2,842,175	323,725
Net after taxes	1,118,241	111,503
Surplus after charges	583,213	107,853

UNITED RAILWAYS COMPANY.

The report of the United Light & Railways Company for the year ended June 30, 1913, shows net earnings of subsidiary properties aggregating $2,361,273, an increase of $331,529 over the previous year. The consolidated income account for June and the twelve months ended June 30 compares as follows:

	1913.	Increase.
June gross	$ 477,175	$ 66,445
Net after taxes	183,684	21,494
Surplus after charges	69,969	1,705
Twelve months' gross	5,698,929	658,188
Net after taxes	2,361,273	331,529
Surplus after charges	1,152,152	233,771

Earnings accruing to securities of the United Light & Railways Company for June, and the twelve months ended June 30, were:

June earnings on stocks owned	$ 67,622
Returns from investments	34,674
Miscellaneous earnings	5,208
Net after expenses and interest	69,646
Surplus after preferred dividends	25,182
12 months' earnings on stock owned	1,049,930
Returns from investments	206,013
Miscellaneous earnings	58,679
Net after expenses and interest	890,716
Surplus after preferred dividends.	445,595

CLOSING BID PRICES FOR ELECTRICAL SECURITIES ON THE LEADING EXCHANGES AS COMPARED WITH THE PREVIOUS WEEK.

	Aug. 4.	July 28.
American Tel. & Tel (New York)	128¼	127¼
Commonwealth Edison (Chicago)	144	142
Edison Electric Illuminating (Boston)	*270	270
Electric Storage Battery common (Philadelphia)	46¾	47½
Electric Storage Battery preferred (Philadelphia)	46¾	47½
General Electric (New York)	139	140
Kings County Electric (New York)	129	129
Manhattan Transit (New York)	1⅝	1½
Massachusetts Electric common (Boston)	14	14½
Massachusetts Electric preferred (Boston)	73	71
National Carbon common (Chicago)	116	114½
National Carbon preferred (Chicago)	113	113
New England Telephone (Boston)	*140½	140½
Philadelphia Electric (Philadelphia)	21⅝	22
Postal Telegraph and Cables common (New York)	77	75½
Postal Telegraph and Cables preferred (New York)	66	65
Western Union (New York)	64	64½
Westinghouse common (New York)	62¼	62½
Westinghouse preferred (New York)	110	108

*Last price quoted.

NEW PUBLICATIONS.

SIDERIAL DEPRESSION.—"Les Depressions Siderales," by Maxime Vincent, has been published by the Librairie Fischbacher, in Paris, France. This presents a new hypothesis of the constitution of matter and celestial mechanics.

FLASH POINT OF OILS.—The Bureau of Mines has issued Technical Paper No. 49 entitled "The Flash Point of Oils," by Irving C. Allen and A. S. Crossfield. This describes the methods and apparatus for determining flash points and gives a bibliography of the subject.

WOOD PRESERVATIVE TREATMENT.—W. F. Goltra, of Cleveland, O., has published in pamphlet form parts IV, V and VI of his treatise entitled "Some Facts About Treating Railroad Ties." The material has already been largely published in the *Proceedings* of the American Wood Preservers' Association.

HEAVY OIL FUEL.—Technical Paper No. 37 of the Bureau of Mines is entitled "Heavy Oil as Fuel for Internal-Combustion Engines," by Irving C. Allen. This considers the different varieties of liquid fuel and their uses, and discusses those that can be used in the heavy-oil engine. Specifications for fuels and for lubricants are included.

WATER PURIFICATION.—The New York Department of Health has issued a report on "The Application of Ozone to Water Purification," by Russell Spaulding. This gives a partial list of European plants using the method, and describes the installation at Paris, with bacteriological tests made there. Results obtained at other points in Europe, including the plant at St. Petersburg, are included. The booklet is profusely illustrated. The consideration of this method for use in America is recommended.

PERSONAL MENTION.

FRED L. KAHN, of Baltimore, Md., has been seriously ill with a bad attack of typhoid fever, but is now on the road to recovery.

JOHN F. PARSONS, for twelve years district manager for the Inter-State Telephone Company with headquarters at Joliet, Ill., has resigned his position because of ill health. He will be succeeded by Jesse M. Brown, former wire chief at Joliet.

CALVIN B. ROULET, one of the early members and for many years the Mercury of the Sons of Jove, now the Jovian Order, has left Texas to accept a position with the National Fire Insurance Company of Hartford, Conn., as general agent of its "Improved Risk Department."

W. J. McDOWELL, secretary of the Chicago Section of the Electric Vehicle Association of America, was appointed by Chairman Homer E. Niesz to represent the Association in connection with the automobile features of Oliver Hazard Perry Day, at Chicago on Saturday, August 23.

FRANK L. PERRY, well known in Chicago for his electrical research work but whose laboratory is now in the Fidelity Building, Baltimore, Md., passed through Chicago last week en route home from California. Mr. Perry has been through the South and was in California making a scientific and business investigation of certain electrical and mechanical processes for a large eastern manufacturing plant.

A. M. RYCKOFF, since taking charge of the selling organization of the King Foundry Company, of St. Joseph, Mo., has been very successful in promoting the sales of King ornamental posts and standards for street lighting, adding many new customers to the company's lists. Mr. Ryckoff, who makes his headquarters in the Manadnock Building, Chicago, was formerly with the Morris Iron Company and has specialized in lamp standards work for a number of years.

MONTAGUE FERRY has been appointed head of the telephone complaint bureau which has been established by the City of Chicago to hear suggestions with respect to subscribers' complaints. Mr. Ferry is a consulting engineer with 12 years' experience in telephone matters, having been connected with the New York and Chicago telephone companies, the Illinois Tunnel Company, the San Francisco Home Telephone Company and the Quincy (Ill.) Home Telephone Company. He is a graduate of Yale and the Massachusetts Institute of Technology.

IRWIN McNIECE, formerly on the erecting engineering staff of the Allis-Chalmers Manufacturing Company, has been transferred to the Salt Lake City office of that company, in the capacity of hydroelectric sales engineer. Mr. McNiece was connected with the old Telluride Power Company, (now Utah Power & Light Company) for a number of years, and refused the appointment of electrical inspector for the City of Salt Lake, to join the Allis-Chalmers Manufacturing Company. Mr. McNiece is a member of the American Institute of Electrical Engineers and has been engaged in electric erecting work out of Milwaukee, prior to his transfer.

ARTHUR L. ROBINSON resigned as superintendent of the mechanical division of the Panama Canal Commission, effective July 20, and with Mrs. Robinson and Miss Cecile Robinson sailed for the United States on Monday, July 21, on the *Cristobal*. Prior to going to the Isthmus, where he arrived on June 4, 1905, Mr. Robinson was head of the electrical department of the Southern Railway. He served as electrical engineer in connection with the electrical and mechanical work of the Commission until October, 1909, when, upon the resignation of George D. Brooke as superintendent of motive power and machinery, he was appointed head of the reorganized mechanical division. In this capacity he made improvements in the management of the shops, one of his changes resulting in an annual saving of $105,000 in overhead expense. On his return to the United States he will visit friends in Harrisonburg, Virginia, before proceeding to his home in Louisville, Kentucky.

GEORGE H. KELLY has been advanced from the position of manager of the truck department to the office of secretary and sales director of the Baker Motor Vehicle Company, of Cleveland, O. R. C. Norton, heretofore secretary and treasurer will continue as treasurer. E. J. Bartlett becomes sales manager of the truck department, and O. B. Henderson continues as sales manager of the pleasure car department. The election of Mr. Kelly as secretary comes after his success in developing the truck department of the Baker Company. Established scarcely more than two years ago, this department has a record of placing trucks not only in every section of the United States, but across both the Atlantic and Pacific; in the cities of Europe, Africa, Japan, South America and Alaska. In giving Mr. Kelly the additional office of sales director, it has been the purpose of the Baker Company to correlate the sales policies of its pleasure car and truck departments under one managing head.

DATES AHEAD.

California State Association of Electrical Contractors. Fourth annual convention, Santa Barbara, Cal., August 13-16.

Michigan Section, National Electric Light Association. Annual convention, Ottawa Beach, Mich., August 19-21.

International Association of Municipal Electricians. Annual meeting, Watertown, N. Y., August 19-22.

Old-Time Telegraphers and Historical Association and Society of the United States Military Telegraph Corps. Annual reunion, Detroit, Mich., August 26-28.

American Electrotherapeutic Association. Annual meeting, New York, N. Y., September 2-4.

National Electrical Supply Jobbers' Association. Fall meeting, Clifton Hotel, Niagara Falls, Canada, September 8-10.

Association of Edison Illuminating Companies. Annual convention, Cooperstown, N. Y., September 8-11.

American Electrochemical Society. Semi-annual meeting, Denver, Colo., September 9-11.

American Institute of Electrical Engineers. Pacific Coast convention, Vancouver, B. C., September 9-11.

Northwest Electric Light and Power Association. Annual convention, Seattle, Wash., September 10-12.

Pennsylvania Section, National Electric Light Association. Annual convention, Delaware Water Gap, Pa., September 16-18.

National Association of Corporation Schools. First annual convention, Dayton, O., September 16-19.

New England Section of the National Electric Light Association. Annual convention, Hotel Vermont, Burlington, Vt., September 17-19.

Illuminating Engineering Society. Annual convention, Pittsburgh, Pa., September 22-26.

Association of Iron and Steel Electrical Engineers. Annual meeting, New York, N. Y., September 22-27.

Colorado Electrical and Industrial Exposition, Auditorium, Denver, Colo., October 4-11.

Colorado Electric Light, Power & Railway Association. Eleventh annual convention, Denver, Colo., October 6.

Jovian Order. Annual convention, Hotel Astor, New York, N. Y., October 14-16.

Telephone Pioneers of America. Annual meeting, Chicago, Ill., October 13-17.

Electrical Exposition and Motor Show of 1913. New Grand Central Palace, New York, N. Y., October 15-25.

Railway Signal Association. Annual convention, Nashville, Tenn., October 14-17.

With the Electrical Manufacturers

Sprague Electric Works of General Electric Company, New York City, has issued bulletin No. 246 on motor-driven exhaust-fan outfits for direct-current and alternating-current circuits. The bulletin is well illustrated with halftones and dimension diagrams of the variety of equipments manufactured and gives complete data on each.

Edison Storage Battery Company, Orange, N. J., has published a very interesting document relating to stories of the National Electric Light Association convention at Chicago. This is one of the most interesting little books that has been brought to our attention and should be in the hands of everyone interested in modern storage-battery practice.

The Standard Electric Tool Company, Cincinnati, O., has ready for distribution a new bulletin (No. U8) devoted to the standard high-power universal portable electric drills. These are compact and powerful tools that can be used interchangeably on either direct-current or single-phase circuits. The various sizes are capable of drilling in steel holes ranging from 0.25 to 1.25 inches in diameter and run at speeds ranging from 900 to 175 revolutions per minute. The bulletin briefly describes and illustrates these tools and gives data on the different sizes.

Universal Electric Stage Lighting Company, 240 West Fiftieth Street, New York City, has issued its Catalog G on electric stage-lighting equipment. This 80-page publication covers a complete array of Klieglight arc lamps for all theatrical and studio purposes, border, bunch and footlights, stereopticons, signs, flashers, dimmers, wiring fittings and supplies, besides a variety of special apparatus and accessories for producing almost every conceivable electrical and electro-mechanical stage effect from the simplest to the most spectacular, mysterious and artistic effects used by the leading theatrical and operatic companies.

Chicago Fuse Manufacturing Company, Chicago, Ill., is sending out to the automobile manufacturing, supply and repair industry, circulars describing the company's new line of union fuse material for automobile electric lighting circuits and similar low-voltage circuits. Included in this category is a steel fuse box with four-wire fiber or hardwood-base cutout, special fuse dips and four types of cartridge fuses from 3 to 15 amperes. The fuse box is a great convenience in centralizing the cutouts in a readily accessible place; it has a hinged cover with spring catch. The fiber cutout block is of such construction as to prevent warping or breakage.

The Electric Welding Company, 220 West Forty-second Street, New York City, has ready for distribution a sixteen-page pamphlet entitled "Scientific Welding." This gives the history and theory of arc welding and points out many important features that must be carefully attended to in order to get the best results. The company has made it its business for several years, both in Europe and this country to do arc welding for a multitude of clients. For this purpose it has a large number of stationary, portable and floating equipments ready for quick and reliable service in its own plants or at any place where the work may be. The pamphlet is well illustrated with a number of typical arc welding jobs executed by the company's staff.

Manning, Maxwell & Moore, Incorporated, of New York City, together with their subsidiary companies, will move their general offices on or about October 1 from 85-89 Liberty Street to the new Lewisohn Building, 113-119 West Fortieth Street (near Broadway and running through to West Forty-first Street). This change is being made to meet the demand for a more convenient and central location, as well as larger space to handle material increases in their various lines, which cover electric traveling cranes, machine tools, engineering specialties, railway, machinists', engineers', factory and contractors' supplies. A large portion of this product is manufactured by their constituent companies, the Shaw Electric Company, the Ashcroft Manufacturing Company, the Consolidated Safety Valve Company, the Hayden & Derby Manufacturing Company, and the Hancock Inspirator Company. They will occupy the twentieth and twenty-first floors of the above building, which will give them 28,000 square feet of space. This space will be exclusively for offices and is almost double that at present occupied for offices on Liberty Street.

Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., has just issued several new publications. Small Motors No. 16 issued by the Industrial and Power Department is devoted to the subject of motor-driven washing machines. A number of interesting views of these popular household devices are shown, together with a description of the various types of machines, and arguments to central stations in favor of handling Westinghouse motor-driven devices of this kind. A list of manufacturers of small motor-driven devices and electric vehicles is also included. "Westinghouse Electrical Equipments for Automobiles and Garages" is the title of a small pamphlet also issued by the company. This folder describes the Westinghouse six-volt, single-wire, starting, lighting and ignition systems developed by the company. Accessories, including meters, rectifiers, vulcanizers, etc., are also described. "Westinghouse Three-Inch Meters" is the title of a little pamphlet describing the different meters having an overall dimension as indicated. These are adapted for automobile battery equipments. They may be obtained in flush and round types. A particular feature is the black painted dial which is said to entirely eliminate the glare present on white-dial meters when illuminated. Type CS squirrel-cage induction motors for constant-speed service are fully described and illustrated in descriptive leaflet No. 2321.

Record of Electrical Patents.

Issued by the United States Patent Office, July 29, 1913.

1,068,404. Alternating-Current Motor. E. F. W. Alexanderson, assignor to General Electric Co. A commutator motor with provision for changing the number of poles and for dynamic braking as an induction generator.

1,068,410. Process of and Apparatus for Coating Electric Conductors. L. W. Chubb, assignor to Westinghouse Electric & Mfg. Co. Consists in moving a wire through a bath and causing simultaneous flow of current through the wire and bath. (See cut.)

1,068,411. Method of and Apparatus for Coating Wires. L. W. Chubb, assignor to Westinghouse Electric & Mfg. Co. The wire is successively drawn through a series of tanks, gas-pressure piping being arranged to prevent mingling of the tank liquids.

1,068,412. Apparatus for Treating Wires and Cables. L. W. Chubb and H. R. Edgecomb, assignors to Westinghouse Electric & Mfg. Co. Wire is drawn through open-top slots in the sides of tank and liquid is maintained at constant level therein.

1,068,413. Method of and Appartus for Coating Wires and Cables. L. W. Chubb, assignor to Westinghouse Electric & Mfg. Co. Wire is drawn about lower submerged part of transformer core so that the secondary current is induced therein.

1,068,426. Vacuum Tube. H. Green, Hartford, Conn. An X-ray-tube cathode has a cylindrical radiating wall extending back from its face.

1,068,427. Engine-Starting Apparatus. E. A. Halbleib, assignor to North East Electric Co., Rochester, N. Y. Includes a storage battery a generator

normally charging the battery and adapted to act as a motor in starting the engine, and in driving a fuel pump.

1,068,432. Thermal Control for Air-Compressors. E. Hill, Norwalk, Conn. Excessive temperature at the outlet valve closes an alarm circuit and electrically opens a discharge from the compressor.

1,068,439. Manufacture of Electrical Accumulators. P. Marino, London, England. Consists in first coating the grids with a composition containing lead oleate and a carbonaceous body, then heating, and finally coating with an acid-resisting material containing gutta percha, asphaltum and lead powder.

1,068,440. Fire-Alarm System. J. J. McCarthy, Newton, Mass. Thermostatic plugs are placed on a lighting circuit and on fusing actuate the alarm through this circuit.

1,068,453. Magnetic Separator. L. G. Rowand, assignor to Wetherill Separating Co., New York, N. Y. Material is dropped onto a rotary armature between opposite field poles.

1,068,462. Spark Plug. H. M. Spencer, Dunmore, Pa. Has a number of radial sparking terminals.

1,068,465. Spacing-Table Carriage. G. P. Thomas, Glenshaw, Pa. Is motor-driven and has an electromagnetic clutch.

1,068,469. Fire-Alarm. J. H. Walsh, South Framingham, Mass. Fusing of a block causes the circuit to close.

1,068,473. Electric Welding-Machine W. C. Winfield and A. C. Taylor, assignors to National Electric Welder Co. and Winfield Mfg. Co., Warren, O. Has specially adjustable work-holders.

1,068,494. Generator, Converter, and Alternate-Current Motor. V. A. Fynn, Blackheath, England. A commutator machine with three stator windings.

1,068,504. Scale. B. W. King, assignor to Standard Computing Scale Co., Detroit, Mich. When the platform is depressed a circuit for lighting the dial is closed.

1,068,521. Automatic Switch for Telephone Systems. G. E. Mueller, assignor to Kellogg Switchboard & Supply Co., Chicago, Ill. The shaft rotates to move the wiper to a row of contacts and then a sleeve moves along the shaft to move the wiper along the contacts.

1,068,531. Electric Motor. H. A. Rhodes, assignor to Universal Motor Co., Denver, Colo. Consists of radially arranged solenoids whose cores form segments of an annular gear connected by intermediate gears to the rotor shaft on which is a commutator and brushes.

1,068,535. Sign Character. R. T. Savage, Spring Lake, N. J., assignor to Savage Novelty Co. The front and rear metal plates are insulated from each other and connected to opposite sides of a circuit; the front plate has lamp-socket shells and the rear plate center contacts therefor.

1,068,558. Electric Furnace. J. Bally, Grenoble, France. A stationary armature with channels connected together to contain the material to be heated and a rotary inductor located in the central space.

1,068,568. Apparatus for Cleaning Articles. E. L. Couch, assignor to Couch-Dean Corporation, Hartford, Conn. A movable belt of electrolytically active material carries the articles into and from chambers containing chemicals.

1,068,573. Protective Device for Printing Presses or the Like. W. Y. Dear and E. S. Cole, assignors to Jersey City Printing Co., Jersey City, N. J. An electrically actuated stop device.

1,068,588. Oil Switch. E. H. Jacobs, assignor to General Electric Co. Includes means for confining the oil put under pressure by the arc and for directing it against the arc.

1,068,615. Electric Furnace and Process of Operating the Same. E. Weintraub, assignor to General Electric Co. Consists in making the material one electrode of a vapor arc and constantly renewing the mercury that constitutes the co-operative electrode.

1,068,616. Weighing and Computing Scale. L. C. Wetzel, assignor to Toledo Scale Co., Toledo, O. An electric lamp illuminates the dial upon the rise of the beam.

1,068,623. Refrigerating Apparatus. W. I. Bodine, assignor to United Iron Works Co., Springfield, Mo. Includes a motor-driven compressor automatically started and stopped according to variation in temperature of the refrigerator chamber.

1,068,625. Tachometer. E. B. Brown, Melbourne, Australia. A combined magneto generator and electric speed indicator.

1,068,627. Locking Device for Telephone Receivers. W. W. Bythiner, Philadelphia, Pa. assignor of one-half to E. D. Bernheim. A clamping disk adapted to engage the enlarged end of the receiver.

1,068,640 and 1,068,641. Secondary or Storage Battery. B. Ford, Philadelphia, Pa. The first patent provides insulating tubes about the active material and an insulating cover over the bottom of the grid. The second patent provides buttons fitting into openings in the grid that are made of coils of lead tape with transverse ribs.

1,068,643. Method of Heating Material by Electricity. W. S. Franklin, South Bethlehem, Pa. The material is mixed with a molten body and passed in a stream from one vessel to another, the outside of the vessels being connected to a circuit so that the current passes through the stream.

1,068,657. Dynamo-Suspension Bar for Car-Trucks. C. H. Howard and H. M. Pflager, assignors to Double Body Bolster Co., St. Louis, Mo. For axle-driven dynamo.

1,068,658. Electrical Heating Device. G. A. Hughes, assignor to Hughes Electric Heating Co., Chicago, Ill. The face plate of a disk stove or range is made of refractory material with parallel channels whose ends are cross connected at the back, exposed resistance wire being in the channels.

1,068,672. Controller. R. F. Le Brocq, New York, N. Y., assignor to Motion Advertising Co. For an elevator car; electromagnetically locked if a door is opened.

1,068,681. Ignition Apparatus. H. Lyon, assignor to Welsbach Light Co. Gloucester City, N. J. Electric ignition for a mantle gas lamp.

1,068,692. Safety Device for Elevator Doors. E. L. Moseley and E. D. Mendenhall, assignors to Safety Appliance Mfg. Co., San Francisco, Cal. Combined door lock and circuit-braker opens the motor circuit if a door is left open.

1,068,699. Mechanism for Stopping Engines. W. G. Potter, Marblehead, Mass. In a steam separator is a hinged cup which swings to close an electric stopping circuit when excessive water is carried over.

1,068,702. System of Electrical Control. W. Robbins and A. H. Timmerman assignors to Wagner Electric Mfg. Co. St. Louis, Mo. Includes a master controller, a main motor, a main controller, an auxiliary motor driving the main controller and an emergency switch to cause the main controller to be driven toward off position.

1,068,706. Electric Cooking Apparatus. L. D. Smith, Detroit, Mich. Electric fireless cooker with removable bottom to give access to heating element.

1,068,707. Method of Treating Carbon and Apparatus Therefor. W. A. Smith, assignor to International Acheson Graphite Co., Niagara Falls, N. Y. An electric shaft furnace having an annular heating chamber and a bottom discharge, and means located in the path of the advancing charge for causing induced currents to traverse the charge.

1,068,716. Apparatus for Producing Hollow Quartz Bodies. A. Voelker, Beuel, and N. Meurer, Cologne, Germany. An electric resistance furnace.

1,068,717. Headlight. R. Wappler, assignor to American Cystoscope Makers, Inc., New York, N. Y. An adjustable head band, an electric lamp and a concave mirror secured thereto.

1,068,740. Electric Heating Apparatus. O. A. Colby, assignor to Westinghouse Electric & Mfg. Co. Includes a removable heating unit and special connecting handle therefor.

1,068,749. Telegraph Apparatus. C. M. Edwards, Galveston, Tex. Electrically controlled punch dies for a tape-punching apparatus.

1,068,757. Secondary Member of Induction Motors. G. H. Garcelon, assignor to Westinghouse Electric & Mfg. Co. Squirrel-cage rotor whose bars make a slight angle with the axis.

1,068,759. Electric Motor for Transmitting Angular Movements. R. Girardelli, Rome, Italy. The receiving motor has a special commutator and brush.

1,068,760. Electrical Cash-Controlling Apparatus. A. Godefroid, Berlin, Germany. Has motor for driving the receipting and registering mechanisms.

1,068,763. Electric Heating Device. W. S. Hadaway, Jr., assignor to Westinghouse Electric & Mfg. Co. Comprises a sheet-metal cylinder and insulating wrapping, resistance ribbon laid on the surface from end to end in zigzag form and successive wrappings of insulaton and sheet metal, and an outer wrapping of band wire.

1,068,774. Electrographic Display Apparatus and Method. M. R. Hutchison, Bronxville, N. Y. Comprises an electrolytically conducting body adapted to produce visible effects in the electrolyte upon passage of electric current in one direction, and to cause such effects to disappear when the current is reversed.

1,068,807. Switching Appliance. M. D. Murray, West Homestead, Pa. A rotary railway turntable with electromagnetic locking control.

1,068,812. Smoothing or Laundry Iron. A. Niola, Newark, N. J. Electric iron with automatic cutout switch.

1,068,825. Winding Machine. A. D. Scott, Providence R. I., assignor to Varley Duplex Magnet Co. The winding guide is supported so that its move-

ments are free to be controlled by the pull of the strand being wound.

1,068,836. Portable Electric Safety Lamp. E. Banick, Newark, N. J. Includes a battery, switch, lamp, reflector, front glass and means for breaking the circuit if the glass is broken.

1,068,838. Combined Taillight and Signal for Automobiles. W. J. Bauer, assignor to B. B. Simons, New York, N. Y. An electric light and rotatable direction-designation signal.

1,068,869. Selective Telegraph System. C. M. Edwards, Galveston, Tex. Includes successive series of electromagnetic selecting devices.

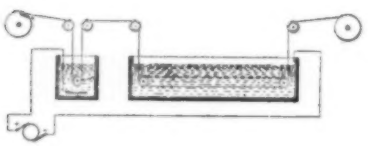
1,068,871. Cooling Device for Telephone-Transmitters for Strong Current. C. E. Egnér, Stockholm, and J. G. Holmström, Saltsjö-Storängen, Sweden. Has a tube for projecting cooling medium upon the heated electrode.

1,068,896. Apparatus for Treating Liquids by Means of Ultra-Violet Rays. V. Henri, A. Helbronner and M. von Recklinghausen, Paris, France. Includes quartz mercury-vapor lamps.

1,068,907. Resister. P. Kraeuter and S. M. Kintner, assignors to Westinghouse Electric & Mfg. Co. Consists of a strip having a thick zigzag web and a thin edge.

1,068,921. Voting Machine. J. Nolan, Long Island City, N. Y. For electrically indicating and recording the vote of individual members of an assembly by means of lamps and electromagnetic printing stamps.

1,068,928. Warning Apparatus for Protection of Valuable Objects. A. L. Pucel, Sceaux, France. Disturbance of the wrapper about the objects closes concealed alarm-circuit switches.



1,068,410.—Coating Electric Wires.

1,068,929. Battery Plate. G. H. Rabenalt, Buffalo, N. Y., assignor to Gould Storage Battery Co. The process of increasing the capacity of pasted plates consists in forcing a fabric die into the paste while soft, and removing the die after the paste has sufficiently set to cause the grooves to remain.

1,068,939. Alarm or Signaling Apparatus. S. Scognamillo, assignor to Salvini Electrical Horn Mfg. Co., New York, N. Y. Horn with motor-driven diaphragm-vibrating oscillator.

1,068,945. Automatic Controller for Explosion-Motor-Driven Mechanism. C. H. Taylor, Detroit, Mich. Includes means controlling the ignition circuit operated upon underflow or overflow of the liquid discharge from a fluid pump.

1,068,949. Telephone Disinfectant Attachment. J. Tichy, Chicago, Ill. Paper is stretched across the mouthpiece between two rolls.

1,068,972. Register for Telephone-Calls. H. S. Brewington, Baltimore, Md. The substation bell rings while the registering mechanism is being actuated.

1,068,994. Mixer. C. Endorf, Jr., Chicago, Ill., assignor to Lindstrom, Smith Co. Includes a motor for driving either of two shafts, pressing down on either shaft closing the motor circuit.

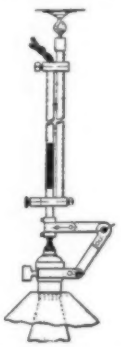
1,068,998. Suspension Support for Electric Lamps. J. P. German and A. O. Pool, Springfield, Mass. The supporting rod and adjoining cord-holding tube are longitudinally adjustable. (See cut).

1,069,014. Trolley Pole and Wheel. J. F. Ireland, Pennville, Ind. The trolley head has two tandem wheels, over which passes an endless chain with trolley-wire-engaging clamps. (See cut.)

1,069,027. Track Relay for Electric Signal Systems. J. J. Ruddick, assignor to United States Electric Signal Co., West Newton, Mass. Has differential windings, one of which is short-circuited when the car passes over an insulated rail section.

1,069,035. Shade-Reflector. J. Sachs, assignor to Sachs Laboratories, Hartford, Conn. Covers half of the lamp bulb, and has an aperture to engage the lamp tip and spring clips to engage the neck of the bulb.

1,069,037. Cable-Winding Mechanism. F. L. Sessions, assignor to Jeffrey Mfg. Co., Columbus, O. Motor-driven haulage-cable reel for an electric locomotive.



1,068,998.—Lamp Adjuster.

1,069,051. Strain Insulator. F. G. Woodlock, St. Louis, Mo. An insulating turnbuckle with internally threaded sleeves imbedded in the ends of the body, threaded bolts engaging the sleeves and a transverse hole through the center to permit turning the body by a tool.

1,069,060. Motor Control. E. L. Gale, Sr., assignor to Otis Elevator Co., Jersey City, N. J. Provides for interconnection of the reversing switches and a stop magnet.

1,069,061. Motor-Controlling System. E. L. Gale, Sr., assignor to Otis Elevator Co. A motor-generator with automatic regulation of the generator field.

1,069,066. Fluid-Pressure Gauge and Automatic Regulator. A. C. Hulbert, San Francisco, Cal. Electric control for the tension device.

1,069,089. Housed Track-Contact for Railway Signaling Systems. B. F. Wooding, assignor to Wooding Railway Warning Device Co., Denver, Colo. Includes two contacts insulated from each other.

Patents That Have Expired.

Following is a list of electrical patents (issued by the United States Patent Office), that expired August 4, 1913.

564,984. Device for Suspending and Supporting Trolley Wires. C. H. Fisk, Washington Court House, O.

564,994. Subway for Electrical Conductors. W. H. Hart, Brooklyn, N. Y.

565,032. Electrical Governor. M. A. Replogle, Cedar Falls, Iowa.

565,046. Telephone Switchboard. A. Stromberg and A. Carlson, Chicago, Ill.

565,053. Electrical Fire-Alarm System. C. D. Tisdale, Boston, Mass.

565,056. Electrotherapeutic Apparatus. H. E. Waite, New York, N. Y.

565,080. Telephone-Substation Apparatus. A. de Khotinsky, Boston, Mass.

565,085. Conduit for Electric Railways. C. D. Mattison, New York.

565,086. Fire-Alarm Signal Box. G. F. Milliken, Boston, Mass.

565,092. Electrolier. N. L. Root, C. L. Reed and D. C. Hale, Longmont, Colo.

565,102 and 565,103. Electric Railway. H. Brandenburg, Chicago, Ill.

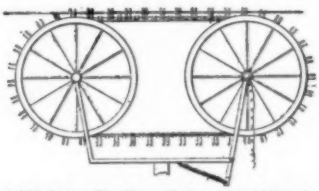
565,128. Combined Typewriter and Telegraphic Transmitter. C. E. Yetman, Oak Park, Ill.

565,136. Electric Sadiron. F. H. Date, J. Heffron, B. H. Scranton and J. Scudder, Detroit, Mich.

565,137. Electric Soldering Iron. F. H. Date, J. Heffron, J. Scudder and B. H. Scranton.

565,138. Distribution and Regulation of Power. H. B. Gale, San Francisco, Cal.

565,139. Method of and Means for Electric Regulation of Power. H. B. Gale.



1,069,014.—Trolley Pole and Wheel.

565,140. Electrode for Secondary Batteries. G. Hubner, Gernsbach, Germany.

565,155. Electric Motor. J. Conner, J. R. MacMillan and A. J. Fuller, Philadelphia, Pa.

565,174. Trolley Wire Support. L. McCarthy, Boston, Mass.

565,178. Electric Cable for Fire-Alarm Systems. H. A. Reed, Newark, N. J.

565,188. Automatic Electric Fire-Alarm. C. D. Tisdale, Boston, Mass.

565,202. Combined Telephone and District Alarm System. F. Drake, San Francisco, Cal.

565,217. Cable for Electric Fire-Alarms. H. A. Reed, Newark, N. J.

565,240. Underground-Trolley System. R. E. Sherman and D. E. Kenyon, Chicago, Ill.

565,244. Circuit-Breaker. W. E. Tobey and H. W. Smith, Pittsfield, Mass.

565,269. Globe for Electric Arc Lights. S. Heimann, New York, N. Y.

565,284. Compound-Wound Polyphase Generator. B. G. Lamme, Pittsburgh, Pa.

565,344. Connecting Device for Electric Conductors. H. Gilmore, Easton, Mass.

565,385. Telephoning From Cars. M. Garl, Akron, Ohio.

565,407. Electric Locomotive. R. Eickemeyer, Yonkers, N. Y.

565,410. Electrical Fire-Alarm System. J. D. Gould, Brooklyn, N. Y.